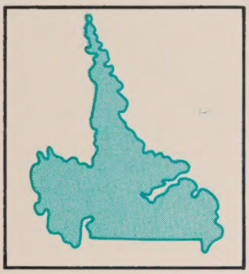
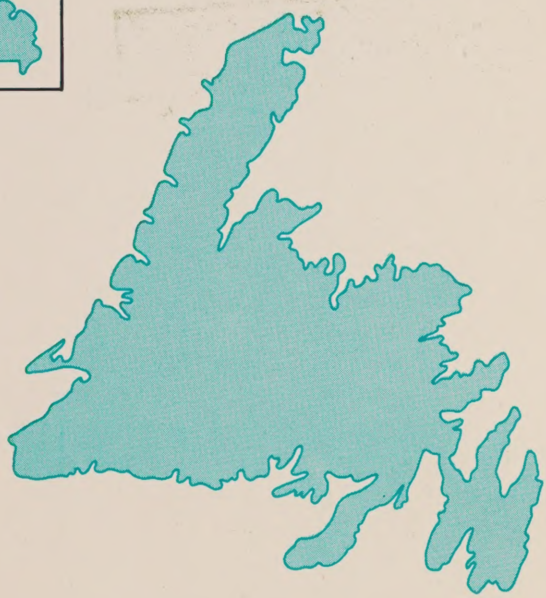
CANADA-NEWFOUNDLAND

WATER QUALITY MONITORING AGREEMENT

WATERFORD & QUIDI VIDI WATERSHEDS SURVEY REPORT 1989-1990





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WATER QUALITY MONITORING AGREEMENT

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WATERFORD RIVER AND QUIDI VIDI WATERSHED

INTENSIVE SURVEY REPORT

1989-1990

Water Quality Section
Water Resources Division
Department of Environment & Lands
St. John's, Newfoundland

Environmental Conservation Branch
Ecosystem Science Division
Environment Canada
Moncton, New Brunswick

Canada-Newfoundland Water Quality Monitoring Agreement

Waterford River and Quidi Vidi Watershed Intensive Survey Report 1989-1990

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LETTER OF TRANSMITTAL

FILE # 1165-4/NF-1

Coordinating Committee
Canada-Newfoundland Water Quality Monitoring Agreement

Dear Member:

During the summers of 1989 and 1990, the Waterford River and Quidi Vidi Watersheds Intensive Recurrent Surveys were conducted under the Canada-Newfoundland Water Quality Monitoring Agreement. On behalf of the Technical Subcommittee members, it is my pleasure to submit to you the final report for these surveys.

Yours truly,

Joseph Pomeroy

Joseph Pomeroy
Aquatic Scientist

<u>Technical Subcommittee Members</u>:

Dr. John Kingston, Newfoundland Dept. of Environment & Lands
Mr. Harold Bailey, Environment Canada

EXECUTIVE SUMMARY

The Waterford River and Quidi Vidi Watershed Intensive Recurrent Surveys were completed during the summers of 1989-1990, as part of the Canada-Newfoundland Water Quality Monitoring Agreement. The objectives of the Surveys were to assess the water quality of the two urbanized watersheds from the headwaters to the heavily developed lower reaches. Assessment was based on organic and inorganic variables from surface water, sediment and forage fish samples.

Results indicated that although both watersheds continue to receive deleterious substances as a result of development, the concentrations of variables in a bioavailable state remain below the Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life. The major inputs are sewage/wastewater, urban runoff and combustion emissions. Although the headwater sites receive few impacts, the mid and lower sections of both basins receive large quantities of sewage and wastewater input. Coliform counts are above the recreational guidelines, whereas the heavy metals quickly flocculate upon entering the Rivers and become less bioavailable. Urban runoff includes the input of organic compounds and an increasing year round leachate of sodium and chloride ions as the soil becomes saturated with winter road salt.

Emissions from the boiler above Long Pond is suspected in the atmospheric deposition of organic compounds and metals into Long Pond, Kents Pond and Virginia Lake.

At present, Recreational guidelines are exceeded in the surface water of both watersheds whereas the guidelines for the Protection of Aquatic Life are exceeded in surface water only during high discharge periods. These periodic increases indicate that the compounds are bound to sediment and resuspend during high discharge periods. During the periods when the greatest percentage of sediment is settled, the bioavailability of complexed compounds are greatly reduced.

ACKNOWLEDGEMENTS

The authors wish to thank Sylvie Roussel (Monitoring & Evaluation Branch) for the collection of samples, and to the National Water Quality Laboratory staff and the Atlantic Water Quality Laboratory staff for their analyses of the various samples. Special thanks to Dr. Tom Pollock and Hugh O'Neill (Monitoring and Evaluation Branch), and Dr. John Kingston (Newfoundland Department of Environment & Lands) for their insightful reviews and to Louise Boulter for her patience in typing this report and drafts.

ABSTRACT

The Waterford River Basin and the Quidi Vidi Lake Basin were surveyed during the summers of 1989 and 1990 under the Canada-Newfoundland Water Quality Monitoring Agreement. Analysis of sediment, forage fish and surface water for the presence of organic and inorganic compounds plus metals were used to study the aquatic environment of these two basins. Results indicate that the headwaters have remained relatively pristine while the lower developed sections have received numerous impacts. The major inputs are untreated sewage and wastewater. These sources contribute elevated coliform counts and heavy metals concentrations on a continuous basis. A secondary input is from urban runoff which is gradually increasing the inputs of organic compounds and road salt to the Rivers. Although the Rivers are continuously receiving elevated concentrations of contaminants, flocculation and flushing maintain an aquatic environment with variable concentrations below the guidelines for the protection of aquatic life.(CCREM 1987)

Sediment samples indicate that the heavy metals and organic compounds settle to the river bed quickly. These contaminants re-enter the water column in a less bioavailable state only during high discharge periods. At these times the compounds are flushed from the upper reaches of the tributaries and settle in a Pond or in the Harbours.

RÉSUMÉ

Les bassins de la rivière Waterford et du lac Quidi Vidi furent étudiés pendant les étés 1989 et 1990 sous l'entente de l'accord Canada-Terre-Neuve pour la surveillance continue de la qualité des eaux. L'eau de surface, des sédiments et des poissons sédentaires furent analysés pour la présence de composés inorganiques et organiques ainsi que pour plusieurs métaux. Les données indiquent que la source est demeurée salubre alors que les sections développées ont subi plusieurs impactes. Les eaux usagées et les égouts non-traités furent identifiés comme étant les impactes majeurs. Ces sources contribuent continuellement à un taux élevé de coliformes ainsi qu'à une concentration élevée de métaux lourds. Les écoulements urbains furent identifiés comme source secondaire. Ces écoulements augmentent graduellement les entrées de composés organiques et de sel routier dans les rivières. Bien que les rivières reçoivent continuellement des concentrations élevées de contaminants, les processus naturels de floculation et de renouvellement maintiennent un environnement aquatique dans lequel les concentrations de variables sont inférieures aux limites pour la protection de la vie aquatique.

Des échantillons de sédiments indiquent que les métaux lourds et les composés organiques se déposent rapidement sur le lit de la rivière pour ensuite réapparaître dans l'eau sous une forme moins bio-disponible lors de périodes de décharges élevées seulement. Ces composés se lient aux sédiments et demeurent dans les rivières jusqu'à ce qu'une décharge élevée les déplacent des étendues supérieurs des tributaires pour les déposer dans un étang ou dans les ports de mer.

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(cms = cubic metre per second)

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1.0 INTRODUCTION

In the summers of 1989 and 1990, the yearly Intensive Recurrent Surveys under the Canada-Newfoundland Water Quality Monitoring Agreement concentrated on two watersheds within the City of St. John's; the Waterford River (1989) and the Quidi Vidi Lake Systems (1990). Both watersheds traverse the core of the City, and only a small portion of the headwaters remain in undeveloped areas.

The Waterford River received an environmental impact earlier than the Quidi Vidi system. The need to address the Waterford River problem was recognized by the Newfoundland Department of Environment in the late 1970s. In response, the Governments of Canada and Newfoundland initiated a five-year study of the Waterford River in 1980. The Waterford River Basin Urban Hydrology Study examined in depth all facets of the hydrological regime. As stated in the Surface Water Study (Arseneault, et al., 1985):

> "The complexity of the study called for a comprehensive approach which included hydrometric surveys, hydrological modelling, ground water studies, biological surveys, water quality assessments, investigations of flooding. and land use and socio-economic analysis"

The Waterford basin is located in the western section of the City and drains an area of approximately 61 km^2 (Arseneault, et al., 1985). The headwaters originate around Brazil and Bremigans Ponds which are located 13 km south-west of St. John's Harbour (Map 1). As the Waterford River flows towards the harbour, it is joined by 10 tributaries and numerous storm-water outflows. The land about the last 7 kilometres of the basin is highly developed and most contamination occurs there.

The Quidi Vidi System (Map 5) is located northeast of the Waterford River. Quidi Vidi Lake, located 1.5 km north of St. John's Harbour receives the drainage from Virginia and Rennies Rivers before flowing into Quidi Vidi Harbour. Virginia River is located to the north of Quidi Vidi Lake. Rennies River which drains Leary's Brook is located to the west of the Lake. The combined catchment area is approximately 75 km^2. A high percentage of the Quidi Vidi Watershed is developed or in close proximity to development. Although the Leary's Brook - Rennies River system passes through the heart of St. John's, a healthy brown trout population continues to grow. Both watersheds have also been the main theme for the development of parks and multi-use recreation areas. The Quidi Vidi watershed has a linear park trail along its banks and a Freshwater Resource Centre is located on Nagles Brook, adjacent Long Pond. Quidi Vidi Lake is a recreational area with the annual Regatta sporting event occurring each August.

This survey addressed the following objectives:

1) to assess the present spatial surface water quality of the two watersheds in relation to use. The data can be used to assess the impact of urbanization on a watershed and direct the preparation of mitigating procedures.

2) to quantify the chemical and bacterial contaminant sources and to define the physical location of such sources.

3) to follow up on the recommendations of the 1980-1984 Waterford Urban Hydrology Survey.

To meet these objectives the water quality data from these two systems will be examined. Organic and inorganic variables of surface water, sediment and forage fish in spatial samples from the Recurrent Surveys of 1989 and 1990 will be the main database. Additional data concerning temporal trends is available from the samples collected monthly under the ongoing Canada-Newfoundland Water Quality Agreement.

Each basin survey is considered individually before making comparisons between the two. To establish the baseline water quality characteristics, headwater sites located in the least impacted areas are addressed first. From this profile, the report will consider in detail each station's or tributary's contribution to the changing characteristics of the water quality. Each system will be followed from the headwater sites through to the receiving Harbours. The tables and figures have been clustered by watershed for the convenience of the reader.

A summation of each basin has also been included at the end of the discussion sections to provide a general overview.

2.0 METHODOLOGY

The Waterford-Quidi Vidi Survey was conducted over a two-year period, 1989-1990. In 1989, the Waterford River watershed was studied. Five stations located in the headwaters of the Waterford watershed were sampled up to five months in advance to obtain temporal water quality information. During a two week period in August 1989, 44 samples were collected. The samples consisted of surface water, sediment, and biota (forage fish). Stations are identified in Table 1.

In 1990, the Quidi Vidi system was surveyed. Five months prior to the intensive survey, four surface water stations were sampled in order to establish temporal water quality conditions. During August 1990, 35 samples were collected to determine the spatial water quality of the system. Samples included surface water, sediment and biota. The station descriptions are provided in Table 10.

Hydrological data for the two systems is available from Environment Canada. The Waterford River discharge for the period of the Recurrent Survey was recorded at three hydrometric stations: Kilbride, Mount Pearl and on the tributary South Brook (Figure 3). The Quidi Vidi system is gauged at three hydrometric stations. Two sites are located on the Virginia River; one at Pleasantville (adjacent to the golf course) and another at Cartwright Place (downstream of Virginia Lake). The gauge on Leary's Brook is located adjacent to Prince Philip Drive upstream of Long Pond (Figure 6).

2.1 SAMPLING PROGRAM

During the Waterford River and the Quidi Vidi System Recurrent Surveys, three matrixes were analysed. From the water matrix, samples were hand collected and analysed for three categories of variables; routine, organics and bacteria. The routine group was sent to the Environment Canada Monitoring & Evaluation Branch Laboratory in Moncton, N.B. This group was analysed for major ions, physical parameters, nutrients and total metals. To complement the routine information, field variables consisting of pH, specific conductance, dissolved oxygen and temperature were collected at each site. The organic group consisted of trace organic compounds in water. Those variables were analysed by the National Water Quality Laboratory in Burlington, Ontario and consisted of organochlorine pesticides (OC), polychlorinated biphenyls (PCB), chlorinated benzenes (CB), polynuclear aromatic hydrocarbons (PAH) and chlorinated phenols. Included with the analyses were quality control samples for organic compounds in the form of blank samples, spiked blank samples and spiked samples. Quality control samples for routine analysis consisted of blank samples for metals analysis. Bacteriological samples were analysed for total and faecal coliforms at the Newfoundland Public Health Laboratory in St. John's.

Sediment samples were analysed at the National Water Quality Laboratory for four groups of variables. Grease and oil, particulate organic carbon and nitrogen, trace organic compounds; (organochlorines, polychlorinated biphenyls, chlorinated benzenes and polynuclear aromatic hydrocarbons), and total metals. Particle size analysis was conducted at the Moncton Laboratory.

Biotic samples consisted of forage fish. This size of fish is resident to a specific area within the watershed, and do not migrate from the sea. Fish were analysed at the National Laboratory for total metal, percent body lipid content and toxic organic compounds; organochlorines, polychlorinated biphenyls, chlorinated benzenes, polynuclear aromatic hydrocarbons, and chlorinated phenols.

Analytical methodology for the analysis of the above matrixes at both Water Quality Laboratories are described in the Analytical Methods Manual (WQB, 1979). Interlaboratory QA/QC practices are described in Agemian (1986), comparability of the Water Quality Branch laboratories was verified and documented by Roussel and Arseneault (1988).

2.2 FIELD METHODOLOGY

Each station was sampled for one or all matrixes and all samples included the basic field measurements; water temperature (°C), pH, specific conductivity (μSie cm^{-1}) and dissolved oxygen (mgL^{-1}).

Routine water samples were collected as discrete or triplicate grab samples in polyethylene or glass containers. Preparation of containers and sampling technique followed the protocol described in "Sampling for Water Quality" (Environment Canada, 1983). Bacterial analyses included total and fecal coliform. Sampling containers and analysis were provided by the Newfoundland Public Health Laboratory in St. John's. Sampling technique was provided by the laboratory, which specified that sample analysis had to be completed within a 24 hour time period. Selected stations along the watershed were chosen for analysis of trace organic compounds. Samples were preserved in the field and sent by truck to the National Laboratory in Burlington, Ontario. The organic analyses also included a number of quality control samples, as is discussed in the Quality Control/Quality Assurance section (6.0).

Bottom sediments were sampled with a 26 cm x 26 cm Ekman dredge sampler, and then transferred to a plastic or stainless steel tray depnding on the analysis requirements. At the centre of the grab sample, 2 cm of top sediment was removed with a stainless steel or plastic scoop, and placed in a similar bowl. Duplicate or triplicate splits were prepared by repeating this procedure at least three times, homogenizing the samples and then dividing the sample into the required number of containers.

Samples for trace organic compounds and particle size analyses were placed in washed aluminum foil trays with aluminum covered cardboard covers. Metals and organic particulate sample containers were polyethylene sediment jars.

Sampled biota consisted of forage fish only. Selected sites were sampled using painted minnow traps, or electro seining. Forage fish containers were the same as sediment containers. Fish samples were analysed at the National Laboratory for metals, trace organics and lipid content.

Field quality assurance/quality control procedures were followed as outlined in Arseneault and Howell (1987).

3.0 RESULTS AND DISCUSSION

3.1 Waterford River Basin

The Waterford River was sampled in August of 1989. Prior to the survey, five stations were located in the headwaters and sampled six months before the survey. These stations were chosen to provide the short-term temporal water quality characteristics of this basin. The two stations located on northern tributaries were:

NF02ZM0075: Kitty Gauls Brook, 0.25 km upstream of Blackmarsh Road (Map 4)

NF02ZM0074: Tributary to Mundy Pond, above Empire Avenue (Map 4)

Three stations located to the south of the Waterford River were:

NF02ZM0072: Bremigan's Pond Stream: 0.75 km downstream of Pond (Map 2)

NF02ZM0073: Unnamed Tributary: 1 km south-east of Bremigan's Pond (Map 2)

NF02ZM0001: South Brook, south of Pitts Memorial Drive (Maps 2 and 3)

3.2 Headwater Sites

The water quality of the headwater sites are mainly influenced by the surficial and bedrock geology. Most of the Waterford River basin flows over the geology of the Conception group, which consist of the Drook and Mistaken Point Formations. The north-western region is underlain by the Drook Formation and the south-eastern by the Mistaken Point Formation. A large percent of the Conception group is composed of marine volcastic sedimentary rock. The Drook Formation consists of siliceous sandstone, tuffaceous silt stone and chert on quartz faces. Mistaken Point Formation geology differs in that the cherts are replaced by shale, creating a softer bedrock. Deposits of iron and manganese based minerals are present in each Formation and exposed fractures soon become stained by oxidation (King 1984). The surficial geology of the basin consists of a thin vegetated till composed of small rocks to boulders. Interspersed throughout the vegetated area are outcrops of rocks and deposits of organic material. (Batterson 1984)

Each headwater site has been impacted to some degree. The least impacted sites, South Brook ZM0001, and the Tributary east of Bremigan's Pond, ZM0073 are within metres of main and/or secondary roads. Bremigan's Pond Tributary, ZM0072 is within 500 metres of a major highway and exposed to the corridor of a power transmission line. The heavily impacted sites are Kitty Gauls Brook and the tributary to Mundy Pond, (ZM0074, ZM0075).

The sites were evaluated based on 29 surface water variables (Table 3). Most variable concentrations fluctuated on a seasonal basis in accordance to the stream's discharge. During spring months when run-off is high, natural variables are diluted and their concentrations are depressed. The variables which are elevated during this period originate from the sea, anthropogenic input and precipitation. During low precipitation, ground water characteristics predominate. Increases in concentrations usually occur during sporadic storms.

The stations were analysed for the trace metals zinc, lead, cadmium, copper and mercury. Results indicated that throughout the six month period, metal concentrations were non-detectable with an occasional value above the detection limit. The low heavy metal concentrations and coliform values of the August survey (Table 4), indicate the absence of storm and sewage outfalls. To distinguish between the two metal groups, the metals which are the most abundant and least toxic at neutral pH will be referred to as "geological metals", as opposed to the heavy metals of the periodic chart of elements. The geological metals include: aluminum, iron and manganese. These metals were analysed by a "total" methodology which refers to a complete extraction in acids. Donovans Industrial Park (ZM0082) had the highest geological metal concentrations (Figure 8),which occurred during the summer months when the ground water supplies a large portion of the waterbody.

During high discharge, nitrogen and phosphorus concentrations increase. The total nitrogen consist of a high percentage of organic nitrogen which indicates the absence of wastewater or sewage.

In the spring months, the pH values range between 4.9 and 5.5 pH units. In summer, these values increase to 6.5 units (Figure 7). The low pH during April can be attributed to the thaw of snow and a diluted alkalinity. The lower buffering capacity (alkalinity) cannot neutralize the protons; therefore, pH decreases until the run-off moderates. In the summer the lower discharge is associated with concentrated alkalinity which provides a buffer for additional hydrogen ion input during storms. This pattern is seen at Kilbride on the Waterford River (Figure 12).

A significant difference between these five headwater sites occur in the concentrations of major ions from road salting operations. Data obtained from the City of St. John's shows a gradual increase of road salt usage (Figure 1). Over an eleven year period, the peaks of usage occurred in 1986, at 29,755 tonnes, and in 1989 at 41,830 tonnes. An equivalent increase of road salt usage occurred in the City of Mount Pearl and Glendale. As a result, the basin is experiencing major sodium and chloride leachate and minor concentrations of other ions year round. An eleven-year pattern at Kilbride (ZM0009) illustrates the increasing leachate (Figure 13). Another source of major ions is sea spray. High concentrations occur after spring thaws and summer storms. The ions (Na^+, Cl^-, SO^-_4) concentrations sharply increase after high discharge periods (thaws and storms) and quickly decrease with run-off. The other major ions are primarily

geological in origin and their concentrations are higher during low discharge when ground water characteristics predominate.

The water quality at the headwater sites is the "best or least impacted" within the Waterford Basin. The following portion of this report will assess the water quality from Bremigan Tributary to St. John's Harbour. As each tributary and sample site station is encountered, its characteristics will be assessed from the viewpoint of how this confluence has influenced the water quality which existed in the Waterford River above it.

3.3 **Bremigan's Pond Tributary** ZM0076, ZM0072, ZM0078

The Waterford River's most westerly tributary is the 3-kilometre Bremigan's Pond Tributary. The headwaters are approximately 13 kilometres west of the Harbour (Map 2). The area is impacted by the Trans Canada Highway and three electrical power transmission lines. The hydrolines cross the stream at numerous places. Approximately 2 kilometres upstream from the confluence with Brazil Pond Tributary, Bremigan's Pond Tributary is dammed. This man-made pond measures 300 by 700 metres at the widest points. The lower reaches of this tributary are developed.

The water quality between the headwaters and the confluence of the Waterford River have differing characteristics. The headwater site ZM0076 is located above the tributary's Pond. In August the pH was very acidic at 4.8 pH units. The low pH was a result of organic acids during the August 7 storm (Figure 2), plus an absence of alkalinity. The negative concentration of alkalinity (-0.6 mg/L) was the result of a high discharge and an initial depressed bicarbonate content. The ground water contribution appears to be high since silica and the geological metals (aluminum, iron and magnesium) are ten-fold the concentration of sites below. The metal concentrations suggest that a favorable environment exist for the leaching of geological metals. A correlation of pH to extractable iron is R= -0.672, which is interpreted as low pH values coincide with elevated iron concentrations. A turbidity of 6.9 JTU's suggest that the metals are complexed with sediment and create a colour level of 160 relative units. A specific conductance of 533 μSie/cm is five times the level of the mid point site. This value is the result of elevated calcium, sulphate, sodium and chloride concentrations. The ratio of sodium to chloride indicates a sea spray from storm precipitation and dry deposition. To determine the source of NaCl, the ratios of seawater ions are used. In seawater, sodium to chloride will always be at a ratio of 1:1.8 units. In other sources like road salt, this ratio is lower at 1:1.5 NaCl units. Sulphate to chloride in seawater is at a ratio of 1:7. Since sulphate concentrations in road salt are low, an elevated ratio may indicate a geological salt source or an atmospheric input as H_2SO_4.

Below the pond, the velocity of the stream increases and the water characteristics change. The pH level increases to 6.1 as a result of an increase in alkalinity from -0.1 to 3.5 mg/L. The lower sulphate concentrations at this site are accompanied by

decreased concentrations of sodium, chloride, magnesium and specific conductance. Geological metals, silica, colour and turbidity concentrations also dropped indicating less ground water input and a flocculation of metals in the Pond. The only variables to increase were DOC and nutrients. The increased DOC levels are associated with an increased total nitrogen concentration. The low coliform, Table 4, nitrate and heavy metal content (Table 2) indicates the absence of sewage and storm water.

A final water sample was collected 100 metres above the confluence with Brazil Pond Tributary (ZM0078). The water quality appears to be influenced by an outfall adjacent the trailer park on the Bremigan's Pond Tributary. pH remained steady at 6.4 pH units which was similar to the above site (Figure 17). Sulphate increased to 9.6 mg/L, and the expected source is sea spray, which would also be the source of an increased sodium and chloride content. These ions plus a slight increase of potassium and magnesium were reflected in the specific conductance which increased to 907 μSie/cm. DOC decreased slightly and coliform, nitrate and phosphorus concentrations increased which are indicative of sewage. Total copper was present at 0.004 mg/L which is above the 0.002 mg/L freshwater aquatic life guidelines, CCREM (1987).

The sediment metal analysis for site ZM0100 is listed in Table 6. Manganese was approximately 3 times above the 1100 mg/kg, and iron (23800 mg/kg) was below the 4 percent Ontario Aquatic Sediment Guidelines (Persaud et al.,1992). Although manganese exceeds the guidelines, a healthy forage fish population exist throughout this system. The only other elevated metal was cobalt (40.2 mg/kg), which is below the 50 mg/kg guideline (Persaud, et al., 1992). Cobalt in natural sediment is usually associated with fine grain clay material. In Quebec Rivers, 40 percent of cobalt was bound to oxides of iron and manganese, and 50 percent was bound to detrital silicate minerals, sulfides and organic substances. Although cobalt does bioaccumulate, biomagnification is not considered significant (CCREM, 1987).

Table 7 lists the results of the sediment organic compound analysis. At site ZM0100 only pentachlorophenol (PCP) was above the detection limit. PCP is commonly used as a wood preservative on power transmission poles and this sample was collected near an electrical power line. The concentration was 215.3 ng/g (0.215 μg/g), which is above the 0.14 μg/g marine sediment guideline for Benthic Community Apparent Effects Threshold (MacDonald et al., 1992). This concentration also exceeds the Interim Remediation Criteria for Soil in Agricultural lands of 50 ng/g, but is less than the 500 ng/g level for Parklands and residential sites. The impact of this compound is unknown because PCP compounds are rapidly bioaccumulated, and quickly excreted.

3.4 **Brazil Pond Tributary** ZM0101. ZM0077. ZM0079

Brazil Pond Tributary is located north-west of Bremigan's Pond Tributary. These two streams join to form the Waterford River. Brazil Pond Tributary is 1 kilometre in length originating at Brazil Pond (Map 2). This tributary is located within a developed area with Topsail Road passing within metres of the headpond.

A sediment sample (ZM0101) was collected near Topsoil Road at the head of Brazil Pond. Table 7 lists the results of the organic compound analysis. 1,3 and 1,2-dichlorobenzene were slightly above the detection limits. The dichlorobenzenes were the most commonly detected chlorinated benzenes in the Waterford Survey (Roussel et al., 1991b). These compounds are used in solvents and pesticides. The other compounds were total polychlorinated biphenyls at 106 ng/g which is the lowest concentration found in this basin. The concentration is slightly above the "lowest effect level" concentration of 0.07 μg/g (70 ng/g), but 3 orders of magnitude below the "severe effect" guideline (Persaud et al., 1992). Because other triplicate samples indicate problems with quantifying PCB, the 106 ng/g at Brazil Pond can only be used to positively identify PCBs presence. The source is likely from an electrical power transformer along Topsail Road. These concentrations indicate the range of values throughout the basin when different sediment compositions are considered.

The sediment metal data (Table 6) indicate that the aluminum is the major metal, whereas iron is one third the concentration found on Bremigan's, and manganese is one tenth. The differences are a result of the changing bedrock and surficial geology. The impact of runoff was evident as grease and oil concentrations were twice those of Bremigan's stream.

The surface water quality was assessed at the Pond's outlet (ZM0077) and at the confluence with Bremigan's Tributary (ZM0079). The water quality at the outlet is similar to the site below Bremigan's Pond (ZM0072). The ion concentrations are low; and specific conductance is 129 μSie/cm. Depressed alkalinity and elevated DOC createa 6.4 pH. The low coliform, nitrate and heavy metal concentrations indicate little or no sewage/storm water input.

Brazil Pond outlet was sampled on August 8 and site ZM0079, above the confluence with Bremigan's tributary was sampled on August 9. According to Environment Canada's hydrometric data, the discharge at Mount Pearl, on the Waterford River dropped from 0.22 m^3s^{-1} to 0.16 m^3s^{-1} within the same period (Figure 2). The slight decrease in discharge on the main River would be magnified on this small tributary and is expected to be a significant factor. The specific conductance at the confluence triples to 312 μSie/cm. A 6-7 fold increase of calcium and sulphate suggest a geological source in the form of a $CaSO_4$ or $MgSO_4$ salt. A correlation matrix found sulphate to be correlated to calcium and magnesium at 0.75 and 0.70. Because the expected ratio of 1:7 SO_4^{-2} to Cl^{-2} in seawater is not present a geological source of sulphate is expected.

Alkalinity increased from 4.6 to 24.2 mg/L, and pH settled at 7.0 units. An increase in turbidity, geological metals, plus a decrease of DOC indicates that the colour is composed mainly of metals complexed to sediment. An increase in phosphorus, nitrate and coliform levels indicate a sewage input. The zinc concentration at the Brazil site is 0.03 mg/L, which is at the surface water guideline concentration for the protection of freshwater aquatic life (CCREM, 1987)(Figure 15). This concentration is higher than that at Bremigan's Tributary.

3.5 **Elizabeth Park Tributary** ZM0080

After Bremigans and Brazil tributaries join, the Waterford River flows approximately 200 metres before joining with a stream to the north. This tributary is 1.5 kilometres long and originates in a residential trailer park north of Elizabeth Park (Map 2). A water quality sample was collected fifty metres above the confluence, and 150 metres below Topsail Road. The data indicates that this stream is receiving sewage from the upstream trailer park. Coliform counts are at the laboratory's maximum level and the nitrate concentration is elevated (Figure 19). Copper, zinc and lead all exceed the recommended surface water guidelines, with zinc concentrations being ten times the 0.002 mg/L guideline. These concentrations are similar to those recorded on the lower reaches of the main Waterford River (Figures 14,15). The turbidity (21. JTU) and DOC (5.7 mg/L) concentrations are also elevated. The higher concentrations of the suspended particles would suggest that the metals are bound to sediment and organic particles. This condition would allow metals to settle out of the water column more quickly and be less bioavailable. The specific conductance and pH are similar to those of Brazil Tributary. Major ions indicate road salt leachate and geological sources. The elevated calcium and sulphate concentrations suggest a geological salt source similar to that of Brazil Pond Tributary (Figure 18).

3.6 **Waterford River at TCH Overpass** ZM0081

This site was sampled to assess the combined quality of the above three tributaries (Map 2). The high heavy metal concentrations from Elizabeth Park Tributary were decreased to detection limit or slightly above (Figures 14,15). If the decrease is attributed to flocculation, then high concentrations of heavy metals are expected in sediment on the lower reaches of Elizabeth Park Tributary. If the decrease is due to dilution, then the impact is non-detectable because surface water concentrations in the Waterford River are below the guidelines and analytical detection limits. The specific conductance decreased as a result of the combined volumes of discharge (Figure 18), and the ratio of sodium to chloride indicates a seasalt source.

A trace organic analysis of surface water is listed in Table 5. The data show that two organochlorine compounds and 1,4-dichlorobenzene were detected. The latter compound is volatile and is often detected as an analytical contaminant (Section 6.3). The organochlorine compounds alpha and gamma BHC (hexachloro-cyclohexanes) were

slightly above the 0.4 ng/L detection limit but below the 10 ng/L guideline for protection of freshwater life. While the use of the insecticide lindane (α-BHC) is very limited in Canada, other countries continue to use it. These compounds are commonly detected in Newfoundland waters and precipitation (Roussel et al. 1990).

3.7 **Donovan's Tributary**: ZM0073 ZM0082

A southern tributary flows through Donovans Park and joins the Waterford River 200 metres below the TCH bridge (Map 2). The tributary is 3.5 kilometres long, originating in the wetland east of Bremigan's Pond. The stream is crossed numerous times by major highways. The headwater site ZM0073 is located 2.5 kilometres above the Waterford River confluence. The water quality is influenced by large organic deposits which stretch from Bremigans Pond to South Brook. The water is highly coloured with a pH of 5.4 pH units and a specific conductance of 144 μSie/cm. A colour content of 240 relative units is the highest of the survey, followed by that of South Brook and Bremigans Pond Tributary. The colour is attributed to the high DOC and elevated geological metals. The heavy metal and nitrate concentrations are low suggesting minor urban runoff. Elevated phosphorus and coliform concentrations indicates some sewage/wastewater input.

The data from five months of sampling reveals a constant pattern of variable concentrations. An increase in specific conductance occurs with each storm and the organic deposits provide high concentrations of DOC, nutrients and colour.

The tributary was also sampled 25 metres above the confluence (ZM0082). This area is well developed. The tributary flows along Highway 1 and near the confluence, the road and stream are separated by a few metres. Numerous roads run adjacent to this tributary, but the largest is the clover leaf, located above the headwater site.

In comparison to the headwater site, the specific conductance increases from 73 μSie/cm to 136 μSie/cm (Figure 18). This increase is the result of calcium, sulphate, sodium and chloride concentrations increasing up to 7 times. The sodium and chloride ratio of 1:1.8 indicates a sea water source, which would also be a source of the sulphate. An alkalinity of 2.4 mg/L is reflected in a pH increase from 5.4 to 6.1 pH units.

Manganese was the only geological metal to increase above headwater concentrations (Figure 16). The only heavy metal to increase was zinc, which rose to 0.07 mg/L. This concentration exceeds the 0.03 mg/L surface water guideline and the expected source is sewage/storm inputs and galvanized culverts (Figure 15). Maximum countable levels of coliform, and elevated nutrients also indicate the input of sewage (Figure 19).

Table 5 lists the results of the trace organic analysis in surface water for site ZM0082. The ubiquitous alpha and gamma BHC were detected, but their concentrations

were below the 10 ng/L guideline. The analytical contaminant 1,4-dichloro-benzene and the PAH, benzo(b)fluoranthene were also detected. The concentration of benzo(b)fluoranthene was 31.9 ng/L and the detection limit was 30.0 ng/L. A quantification deviation exists with trace organics near their detection limit and this value should be viewed with caution. Other factors which affect the validity of this compound's presence are the facts that high weight PAHs have a high affinity for sediment, and they are degraded by natural processes (photolysis) when present in the water column.

A forage fish sample was analysed for organic compounds and total metals (ZM0082, Table 8). Five PAH compounds were detected. Of these, benzo(a)pyrene and 2-methylnaphthalene were slightly above their detection limits and phenanthrene, fluoranthene and pyrene were 1.5 to 2 times the analytical detection limits. These concentrations should only be used to represent a positive detection. According to USEPA (1979) those compounds which are absorbed into sediment can be biodegraded or biotransferred by biota. Field notes indicate that this site contained numerous forage fish, therefore, these levels are below lethal effect concentrations.

A comparison of metal concentrations in the forage fish (ZM0082) to data of forage fish in 3 Atlantic provinces (Bailey, 1988) shows elevated concentrations at this site. Copper at 4.67 mg/kg is higher than that found in the Northwest Miramichi/Tomogonops (1.3 mg/kg), Exploits (0.32-0.47 mg/kg), Salomon/Mira Rivers (0.57-1.9 mg/kg) and was the highest from the Waterford River. Zinc at 51.9 mg/kg was 4 to 5 times that of the Exploits River (6.0-12.0 mg/kg - Red Indian Lake), but below the 81.0 mg/kg of the Northwest Miramichi/Tomogonops where a mining operation is ongoing. Lead was also higher than that of the Exploits River, and the Mira and Salmon Rivers, N.S. Mercury was 1 order of magnitude below the 0.5 mg/kg guidelines for total mercury in whole fish(IJC, 1976). Because metal concentrations were elevated in the forage fish, sediment from this area is expected to contain high metal concentrations.

3.8 **Waterford River at Donovan's** ZM0003

The Waterford River was sampled 300 metres below the confluence of Donovan's tributary (Map 2). This sample was collected after the August 6-7 rain event (Figure 2).

As the coliform counts of both the tributary and the River were at 600/100 mL levels, dilution by either branch was not possible. The result is an elevated fecal coliform count and high nutrients (Figure 19). The 0.07 mg/L zinc concentration from Donovan's Tributary is diluted to 0.04 mg/L which is similar to site ZM0081, above Donovan's (Figure 15). A higher turbidity, iron and manganese content indicates that sediment complexed with metals are present in the water column. A drop in specific conductance is the result of the Donovans Tributary's major ions being diluted.

A forage fish sample was collected in duplicate and analysed for trace organic compounds. In both samples (Table 8), all compounds were below or at the analytical

detection limit. The concentration of mercury was 0.09 and 0.08 mg/kg which is the highest of the survey, but below the 0.5 mg/kg guidelines for total fish flesh weight (IJC, 1976). Copper concentrations (2.99 mg/kg) decreased over the upstream site, but were above the 0.32-1.9 mg/kg found in rivers influenced by mining (Bailey, 1988). Zinc increased to 58.3 mg/kg in comparison to 51.9 mg/kg at ZM0082. This concentration is 4 to 5 times the 6.0-12.0 mg/kg found in the Exploits River, but below the 81 mg/kg found on the Northwest Miramichi/Tomogonops (Bailey, 1988). The high concentrations of zinc and copper may partly be a result of physiology. These elements are essential minerals, and they may bioaccumulate by a factor of 1000 (Bailey 1988).

3.9 **Tributary West of Glendale** ZM0083

One kilometre downstream of Donovan's is a tributary which drains the area between the Glendale subdivision and Donovan's Tributary (Map 2). The development of Donovan's and Glendale subdivisions are slowly engulfing this tributary, and the impact is significant. The elevated coliform and nutrient levels indicate the input of sewage and wastewater. Copper concentration of 0.003 mg/L exceeds the 0.002 mg/L surface water guideline for protection of aquatic life (CCREM, 1987). Iron and manganese also decrease as the geology changes from the Conception Group to the St. John's Group. The Mistaken Point Formation of the Conception Group continues to influence the aluminum concentrations by increasing the concentration to 0.12 mg/L. The average specific conductance of this triplicate sample is 346 μSie/cm. The major ions influencing conductance are sodium and chloride. An alkalinity of 3.5 mg/L produces a 6.4 pH. This quality control sequential triplicate sample produced results which are representative of the sample site.

3.10 **Waterford River at Glendale - Mount Pearl** ZM0004

To assess the influence of the Glendale Tributary on the Waterford River, sample ZM0004 was collected below the tributary and above the Glendale-Mount Pearl Bridge (Map 3). Overall, the water quality of the Waterford River after the Glendale tributary improved marginally. Coliform levels remained at 600/100 mL and phosphorus decreased. The doubling of nitrate is the result of hydroseeding, which had recently occurred. The 0.003 mg/L concentration of copper from the tributary was diluted to 0.0018 mg/L by the upper Waterford River, whereas the concentration of other metals remained constant. The concentrations of turbidity, colour and geological metals decreased, and specific conductance in the Waterford River dropped from 745 to 684 μSie/cm (Figure 18). The organic compound analysis detected only alpha and gamma BHC. The concentration of 0.61 ng/L is the second highest value of the survey, but below guidelines.

In an easterly direction along the Waterford River, the geology changes to the St. John's Group, Fermeuse Formation. This geology consists of grey to black shales, siltstones and sandstones (King, 1984).

3.11 **Branscombe's Pond Tributary** ZM0087

Branscombe's Pond tributary enters the Waterford River 2.4 kilometres below site ZM0004, and the Glendale-Mount Pearl Bridge. This northern tributary drains Branscombe's Pond and the area west of Kitty Gauls Brook. The 2 km^2 catchment area lies between Empire Avenue (North) and Topsail Road (South). The sampling site is 300 metres upstream of Topsail Road (Map 3).

Although this tributary is enclosed by development, the impact is low. The data error in Table 4 should indicate fecal coliform as being 120/100 mL since fecal must be lower or equal to total counts. This value plus the low phosphorus, copper, lead and cadmium concentrations indicate an input of sewage is entering this stream. Galvenized culverts in the area are likely the source of the 0.03 mg/L zinc concentration since other heavy metals are low (Figure 15). A high calcium concentration is reflected in the 9.5 mg/L alkalinity and 7.1 pH levels. A specific conductance of 440 μSie/cm likely increases during storms since the present sodium:chloride ratio indicates sea spray. This sample was collected as a quality control triplicate and the data indicate a representative sample.

3.12 **Waterford River at Dunn's Bridge** ZM0012

The Waterford River was sampled above the Dunn's Road Bridge, and adjacent to Branscombe's Pond tributary confluence (Map 3). Discharge from the tributary had minor influences on the River. Only nitrate changed, increasing from 0.28 to 0.32 mg/L at site ZM0012 below the tributary.

3.13 **Tributary North of Mount Pearl** ZM0086

Downstream of Dunn's Bridge, a tributary south of Glendale and north of Mount Pearl enters the Waterford River (Map 3).

The site is slightly above the confluence with the Waterford River. The water quality is characterized by low geological metals and high major ions. The high silica concentration suggest a substantial ground water input. A low coliform value suggest minor sewage/storm water inputs. The elevated nitrate concentrations of 1.4 mg/L is likely from runoff, but field records did not note excessive aquatic plant growth.

3.14 **Waterford River below the Mount Pearl tributary ZM0085**

To assess the impact of the Mount Pearl tributary, a sample was collected 300 metres below the Dunn's Road Bridge, and below ZM0086 (Map 3). The tributary diluted the River's coliform concentration from 500 to 350/100 mL sample, and the tributary's nitrate concentration was diluted from 1.4 mg/L to 0.39 mg/L (Figure 19). Specific conductance and pH levels remained similar.

A water sample was analysed for trace organic compounds. The ubiquitous alpha and gamma BHC compounds were measured slightly above the detection limit and the contaminant 1,4-dichlorobenzene was also detected. A fourth compound detected was pyrene, a high molecular weight PAH. Pyrene was measured at 38.2 ng/L, and the detection limit is 13 ng/L. This concentration should be viewed with caution since pyrene was not detected at other sites and other PAHs were not detected at this site (Section 6.3).

3.15 **Flings Brook Tributary ZM0088, ZM0006, ZM0084**

Three hundred metres below ZM0085, the 3-kilometre Flings Brook tributary empties into the Waterford River. The tributary's catchment area includes that area between the Experimental Farm, Old Placenta Road and west into the City of Mount Pearl. Three samples were collected along this tributary. A headwater sample (ZM0088) on the south branch above Old Placentia Road, sample ZM0006 below the Experimental Farm property, and sample ZM0084, a water and sediment sample 100 metres above the confluence with the River (Map 3).

Most variables decreased sharply between the upper and mid station, and then gradually decreased between the last two sites. The high concentrations of variables in the headwaters reflect the composition of the Fermeuse Formation which consist of seriate, albite, quartz and trace deposits of calcite, dolomite, pyrite, magnetite and apatite (King, 1984).

The headwaters (ZM0088) originate from ground water and runoff. The specific conductance of 497 μSie/cm was the highest value on Flings Brook. The main ions were calcium, potassium and magnesium. Sodium, chloride and sulphate concentrations were low and the 1:1.5 ratio of sodium to chloride suggest a road salt leachate. An alkalinity of 35.7 mg/L produces a pH of 7.2 units. The large organic deposits of the headwaters are similar to the headwaters of Donovan's Tributary and South Brook. These deposits contribute elevated iron and manganese which cause the highly coloured waters (200 relative units). Field notes indicate that the stream had been diverted from its original bed which would provide the elevated metal concentrations. The low coliform and nitrate values indicate the absence of waste/sewage waters. A slightly elevated zinc is likely the result of galvanized culverts. Approximately 2 kilometres downstream, Flings Brook was resampled at the Experimental Farm property (ZM0006). The specific conductance decreases to 404 μSie/cm which is the result of decreasing sodium and chloride concentrations. The decrease of DOC and geological metals resulted in a drop in turbidity and colour. The lower concentrations are a result of the absence of organic deposits in this area. The increase of nitrate and coliform indicates the input of sewage and wastewaters. Possible sources are from the lower end of Mount Pearl, input from houses within the 2 kilometre area, and runoff from the Experimental Farm property. This sample was collected in triplicate as part of the quality control procedure. All values except mercury were within an acceptable range. The second sample contained mercury

at twice the concentration of the other two. The concentration will be based on the two similar values, which are less than the 0.18 μg/L detection limit.

Upstream 100 metres of the confluence with the Waterford River, the last site on Flings Brook was collected (ZM0084). This site is approximately 900 metres downstream of the midpoint site. This area diverts away from the Old Placentia Road. The ions are similar to the mid site, but the lower sodium and chloride concentrations indicates a sea water ratio. These differences resulted in a lower specific conductance of 379 μSie/cm, but a constant pH (Figures 18,17). A sharp decrease of iron and manganese in contrast to the headwaters was reflected in low turbidity and colour. Coliform levels remain above the 600 countable level and a doubling of phosphorus and tripling of nitrate indicate sewage-wastewater input (Figure 19).

A sediment sample was collected in duplicate at this site (ZM0084) and analysed for metals and organic compounds (Tables 6,7). The percent content of organic carbon and nitrogen particulates are similar to that of Bremigan's and Brazil Tributary. All the metals except for zinc were acceptable as natural background concentrations (Figure 22). Roussel et al. (1991b) concluded that zinc concentrations at this site could be considered enriched. The organic compounds detected included six high molecular weight PAHs and two chlorinated benzenes. The PAH concentrations were 3 to 20 times those of background levels in Atlantic Canada, but 5 to 25 times below the concentration found in Mundy Pond and St. John's Harbour. The presence of the wood preservative pentachlorophenol in one sample of the duplicate may be a false positive since the concentration was at the analytical detection limit. 1,3-dichlorobenzene was also detected at 5 to 10 times the concentration of that in Mundy Pond and St. John's Harbour. A possible source is from herbicides and insecticides. Literature list 1,3-dichlorobenzene as the least produced chemical of its dichlorobenzene isomers (CCREM, 1987).

3.16 **Waterford River above South Brook ZM0089**

To assess the influence of Flings Brook on the Waterford River, a sample was collected 300 metres above the South Brook Tributary. The water quality at this site will also be influenced by the northern Kitty Gauls Brook (ZM0076). Kitty Gauls Brook was sampled only in the headwaters (Tables 2,3, Map 3). The impact upon the Brook as it passes through the Waterford Hospital grounds and under major roads is unknown. Because of the unknown final characteristics of Kitty Gauls Brook, the water quality at site ZM0089 (above South Brook) will be assessed in relation to Flings Brook and the upper Waterford River site, ZM0085 (above confluence with Flings Brook).

The fecal coliform count of 350 from below the Mount Pearl tributary increased to the 600 maximum countable level at site ZM0089. From this site onward the Waterford River's coliform concentrations remain above the 600 maximum countable levels (Figure 19). The higher tributary's values for turbidity, DOC and colour cause a slight increase of concentrations in the Waterford River. pH remains constant at 7.5 units, alkalinity

increases to 15.5 mg/L, and specific conductance increases from 599 to 636 μSie/cm. The higher concentrations of phosphorus (0.1/mg) and nitrate (0.79 mg/L) are probably from Kitty Gauls Brook since Flings Brook concentrations are similar to those of the upper site on the Waterford River (Figure 19).

The organic analysis detected three compounds above the detection limit; alpha and gamma-BHC and 1,4-dichlorobenzene (Table 5). As in other samples, the first two are ubiquitous and at low concentrations; whereas the third is a contamination problem (Section 6.3).

A forage fish sample was analysed for organic compounds and metals (Table 8). The organic analysis detected four compounds: p,p-DDE, p,p-TDE, HEOD/Dieldrin and Total PCB. The chlorinated hydrocarbons were detected at 2 to 3 times their detection limit; whereas, the concentration of Total PCB was at 106 ng/g. The PCB value should be considered with caution since, concentrations near the analytical detection limit (90 ng/L) can produce a large degree of variance. p,p-DDE and p,p-TDE are the primary metabolites of DDT. These compounds were historically used in pesticides and continue to be detected because they are persistent in nature and can biomagnify up to 100 times. Of the four compounds, only dieldrin was detected in the surface water at an adjacent site on South Brook. The concentration of 0.58 ng/L was above the 0.4 ng/L detection limit, but below the 4 ng/L guideline. Because of the low concentration and the restricted use, this compound's presence should be viewed with caution.

The metal analysis of the forage fish show mercury concentrations have decreased slightly in comparison to upstream samples, Cadmium concentrations increased to 0.06 mg/kg which is above the 0.05 mg/kg found in fish from the Exploits. Other metals decreased slightly but remained above the concentrations found in the Exploits River (Nfld.), and the Mira and the Salmon Rivers (Nova Scotia) (Bailey, 1988). Similar high metal concentrations were present in the forage fish tissue and sediment of Mundy Pond and the Rivers outlet.

3.17 **South Brook ZM0001, ZM0007, ZM0090**

Three hundred metres downstream of site ZM0089, the Waterford River joins its largest tributary; South Brook (Map 3,4). This tributary is 9 kilometres in length originating to the south of Bremigans Pond and Donovans tributary. The impact on this watershed consist of electrical power-lines, secondary highways and heavy development. Two tributaries join South Brook from the west of Petty Harbour Long Pond. Both are heavily impacted by roads and development. South Brook was sampled at three locations: the headwaters south of Mount Pearl, above the tributaries, and above the confluence with the Waterford River. Each tributary was sampled above the confluence with South Brook. The water quality of South Brook differ between the upper and lower stations. Variation is due to pollution and geology. The headwaters flow over the Drook Formation of the

Conception Group, whereas the lower sections flow over the Fermeuse Formation of the St. John's Group.

The headwater site ZM0001 was sampled over 6 months previous to the survey (Section 3.1). The Brook is lightly coloured at 70 relative units versus 200 relative units at other sites (Table 3). The colour is due to low concentrations of iron and manganese. This site is above a primary road, and the NaCl ratio is close to a 1:1.5 ratio which indicates a road salt leachate. The concentration of major ions and the specific conductance (43 μSie/cm) were the lowest in this basin. An alkalinity of 4.0 mg/L produced a pH of 6.5 units. Low nutrients, heavy metals and coliform concentrations indicate the absence of storm or sewage outfalls.

The surface water organic analysis detected only low concentrations of the ubiquitous alpha and gamma-BHC.

Downstream 2.5 kilometres, the Brook was resampled at site ZM0007 (Map 3). Coliform, nutrient and heavy metal concentrations have fluctuated slightly suggesting a possible sewage or wastewater input. The sodium to chloride ratio has increased to 1:1.8, which indicates a salt water source, and specific conductance increases to 126 μSie/cm. A decrease in colour and turbidity is accompanied by a decrease in DOC, iron and aluminum concentrations. These lower concentrations indicate that complexed metals and particles have settled out of the water column over the past 2 kilometres.

Approximately 1 kilometre downstream of site ZM0007, a southern tributary flows into the Waterford River (ZM0008). The tributary is 1.6 kilometres long and flows through a highly developed area west of Petty Harbour-Long Pond. The impact of development on the water quality is evident. The 600/100 mL maximum fecal coliform counts and increasing nitrate and zinc concentrations indicate the inflow of sewage-storm water. A specific conductance of 361 μSie/cm is attributed to runoff, and newly exposed bedrock. The major ions, calcium, magnesium, sodium and chloride all increased. The major ion ratios do not indicate a sea water source, hence both road salt or sea spray likely contribute. The increase in calcium and manganese plus a decrease in aluminum and iron, are attributed to the newly exposed bedrock. An increase in alkalinity resulted in a pH of 7.0 units.

Approximately 2 kilometres downstream, a tributary which originates in Petty Harbour Long Pond flows west 1.5 kilometres into South Brook. The collection site, ZM0096, was located 0.5 kilometres upstream (Map 3). The impact of development along the lower section is evident. Storm and sewage outfalls result in high counts of coliform and high concentrations of phosphorus. The specific conductance drops to 314 μSie/cm as a result of decreases in calcium, magnesium and potassium. Alkalinity of 11.5 mg/L maintains a pH of 6.9 units. The low colour and 3.4 JTU turbidity is associated with decreasing DOC and iron concentrations. A small rain event on August 13 also contribute to increased turbidity.

South Brook flows 0.5 kilometres to the Waterford River. Site ZM0090 was located above the confluence with the Waterford River. The lower stretches are within 100 metres of two major highways. Although the impact is evident, the largest deterioration of water quality comes from the previous two tributaries. The high coliform and nitrate levels from the tributaries cause high levels at the present site (Figure 19). The elevated zinc and copper concentrations are diluted to their detection limit. Although sodium and chloride concentrations have remained consistent, calcium, sulphate and potassium have increased sharply. These concentrations are reflected in a specific conductance of 408 μSie/cm (Figure 18). The source of these ions is probably newly exposure bedrock. The associated bicarbonate results in an elevated alkalinity and a 7.4 pH (Figure 17).

A trace organic sample detected alpha and gamma-BHC, the contaminant 1,4-dichlorobenzene, and HEOD/dieldrin, an organochlorine pesticide. The concentration of dieldrin was 0.58 ng/L which is an order of magnitude below the 4.0 ng/L guidelines for the protection of aquatic life. This compound was also detected in a forage fish sample at site ZM0089 on the Waterford River. Because this compound is no longer used, and the detection limit is 0.4 ng/L its presence may indicate a false positive value which should be viewed with caution.

3.18 **Waterford River at Kilbride ZM0009**

Kilbride is a community located at the confluence of South Brook and the Waterford River. A hydrometric gauge is located here and records the discharge from South Brook and the Waterford River (Map 4).

Table 6 shows particle size analysis of sediment collected at Kilbride. Sand grains compose 82 percent, 11.3 is silt and 6.7 is clay. This sample will contain lower amounts of compounds because of the large portion of sand. Tables 6 and 7 list the results of metals and organic compounds.

Roussel et al. (1991b) reported that only the zinc concentrations at Kilbride were enriched (Figure 22). The organic compound analysis identified three compounds above the detection limit; phenanthrene, fluoranthene and pyrene. The concentrations were 2-4 times their detection limit and were the lowest of the Survey. These concentrations may be a result of the high sand content since concentrations at Flings Brook (Section 3.15) were 4 to 5 times higher.

A surface water sample was collected at Kilbride on August 14 as part of the 1989 survey. The sample was collected under the Agreement program, but analysis occurred at the National Laboratory in Burlington, Ontario.

The merger of the two waterways allows South Brook to dilute the higher concentrations of the Waterford River. Specific conductance decreased from 636 µSie/cm in the Waterford River (ZM0089) to 578 below Kilbride (ZM0091). The only variable to increase was DOC which is attributed to an organic deposit near Kilbride.

The long term Kilbride data provides a temporal overview during 1986 to 1989 (Table 9). The hydrological data is displayed in Figure 4. Each year spring freshets are followed by low summer volumes which sometimes average below 1.0 m^3/s. During 1981 to 1991, the specific conductance varied between 188 to 2066 µSie/cm (Figure 13). The highest peaks occurred in winter and were caused by sodium and chloride concentrations from road salt. In 1988, 40,000 tonnes of road salt was applied and in January, the specific conductance peaked at 1624 µSie/cm. Another peak occurred in December 1988, at 2000 µSie/cm.

The other ions which influence to the specific conductance are calcium and sulphate. At the onset of a storm Na^+, Cl^-, SO_4^- increase which cause a rise in conductance and a decrease in pH (Figures 12,13). As the storm continues, ground water brings more calcium and associated carbonate into the River. When the precipitation ceases, the Na^+, Cl^-, SO_4^- input decreases, and conductance decreases and pH slowly increases.

Another result of discharge is the flushing of sediment from the River. During high discharge, turbidity, heavy metals, DOC and nutrients increase (Figure 11-13). During lower discharge periods, barriers above Kilbride such as the Park's Pond, provide a settling area and capture the sediment. The heavy metal concentrations often exceed the guidelines for the protection of aquatic freshwater life during high flow and return to concentrations below the guidelines during low flow periods (Figure 21). The settlement of sediment behind the dam at Kilbride is reflected in the high sand content below the dam.

3.19 **Waterford River below Lane Bridge ZM0091**

Approximately 1 kilometre below Kilbride the Waterford River was reassessed at station ZM0091 (Map 4). This site is 200 metres below the Lane Bridge. The concentration of both total and faecal coliform were at the maximum countable levels. The lower concentrations of DOC were associated with lower concentrations of organic nitrogen. The slight increase in nitrate and turbidity were attributed to the sewage input. From this site to the Harbour, the River flows within metres of urban development and roads. The greatest amount of impact in the basin occurs through this corridor.

3.20 **Beaver Brook Tributary ZM0095**

Beaver Brook tributary joins the Waterford River 0.5 km below the Lane Bridge. This tributary is approximately 1.0 kilometre long and originates east of the Waterford River at Beaver Pond (Map 4). To the immediate east of the Pond is Black Head Road. This road runs from the Harbour to Cape Spear, Canada's most easterly point of land. Beaver Pond is situated 152 metres above sea level in the South Side Hills. This range of Hills stretch between Kilbride-Petty Harbour Long Pond to the Narrows of St. John's Harbour. The elevation of 152 to 213 metres occurs in less than 800 metres, making the terrain unsuitable for development.

Two samples were collected: a sediment sample in Beaver Pond, and a water sample (ZM0095) 0.5 kilometre upstream of Waterford River. The sediment sample was collected in the northeast section of Beaver Pond closest to Blackhead Road. The triplicate sample (ZM0103) was analysed for metals and organics (Table 6). The data indicates a non-homogenized sample. Roussel et al. (1991b) concluded that all metals were within expected natural background levels.

Table 7 lists the results of the organic compound analysis. The analytical contaminant 1,4-dichlorobenzene and polynuclear aromatic hydrocarbons were present. The concentrations of the PAHs were between 66.7 ng/g to 230 ng/g. These concentrations are magnitudes below those found at the River's outlet and in Mundy Pond. Benzo(a)pyrene was detected at 151 ng/g, which is below the 1000 ng/g guideline for the protection of freshwater fish (IJC, 1983).

A water sample was collected 0.5 kilometre above the confluence with the Waterford River. Low coliform, nutrient and heavy metal concentrations indicates the absence or small volume of sewage (Figure 19). The geology of the St. John's Group, Gibbett Hill Formation consist of low concentrations of ions which are reflected in a specific conductance of 163 μSie/cm (Figure 18). The sodium and chloride ratio of 1.8:1 indicates a sea water origin. A DOC of 4.4 mg/L indicates organic deposits in the headlands.

3.21 **Waterford River at Syme's Bridge ZM0092**

One kilometre below Beaver Brook, the Waterford River was sampled at site ZM0092 (Map 4). This site is located above Syme's Bridge which crosses the Waterford River. The area is developed, but the impact on water quality is slight. The coliform count remained at analysis maximum counts, and nutrients and heavy metals were similar to site ZM0091, indicating minor sewage input. The only organic compounds detected in surface water were alpha and gamma-BHC. The concentrations were below the 10 ng/L guideline (Table 5).

3.22 **Waterford River above South Side Overpass ZM0097**

Site ZM0097 was sampled 0.5 kilometre below Syme's Bridge (Map 4). The sample was collected at an outfall pipe which drains the subdivisions of Cornwall Height and Cornwall Crescent. A specific conductance of 315 µSie/cm, elevated coliform, copper and mercury concentrations, and low concentrations of nitrates/nitrites indicated urban runoff. The copper and mercury concentrations are 7 to 10 times above the guideline for protection of freshwater aquatic life (Figure 14) (CCREM 1987). An alkalinity of 27.1 mg/L produced a pH of 6.6 pH units.

3.23 **Mundy Pond Tributary ZM0074, ZM0109, ZM0102, ZM0094**

Mundy Pond Tributary joins the Waterford River approximately 400 metres below the South Side Overpass (Map 4). The tributary originates in Mundy Pond approximately 1.5 kilometres upstream. Mundy Pond Brook which feeds Mundy Pond originates 2 kilometres west of the Pond in the Pennywell Road - Wishing Well Road area. The headwater site ZM0074 was located below Pennywell Road. A triplicate sediment sample, and a forage fish sample were collected in Mundy Pond and the final sample was collected at the confluence, ZM0094.

The headwater site ZM0074 was sampled six months prior to the survey (Table 3). The pH fluctuated near 5.0 units, as a result of a less than 1.0 mg/L alkalinity. Specific conductance ranged between 200-300 µSie/cm. High ion concentrations were recorded throughout the year as a result of winter road salt leachate, and sea-spray input (Figure 9).

During low precipitation, geological variables reach their maximum values, because the characteristics of ground water predominate. High concentrations of iron, manganese and DOC, cause turbidity and colour to increase to yearly maximums (Figure 8). Although this site is located in a developed area, low faecal coliform, nutrient and heavy metal concentrations indicate the absence of sewage input.

The August sample from ZM0074 was collected as a triplicate quality control sample (Table 21). All variables in the triplicate were within the 10 percent range for acceptability. The sample contained variable concentrations, at a low water extreme (Figure 2). Elevated calcium, sodium and chloride concentrations contributed to a specific conductance of 260 µSie/cm, alkalinity of less than 1.0 ng/L and a pH of 5.1 units. The colour level of 110 relative units and high turbidity was a result of high iron, manganese and DOC levels. These variables appear to settle out in Mundy Pond, since values at the confluence dropped significantly.

The Mundy Pond sediment contains high concentrations of metals and organic compounds as a result of the impact the Pond has received over the years. As St. John's expanded, numerous "outcrop" areas of the Pond were infilled using fill from

construction and demolition projects. During the period of 1965 to 1981 the Barber Green Batch Asphalt Plant was located at the Municipal depot site adjacent to the Pond. The solid waste from the 30,000 tonnes of product was transported to the Robin Hood Bay Landfill site, but the liquid effluent drained into the local storm system. Presently, the City operates a seasonal mobile asphalt plant at the site, but stringent guidelines protect the watershed.

Table 6 lists the metal analysis of the sediment samples (Figure 22). All the variables were within an acceptable range of reproducibility indicating a representative sample. Roussel et al. (1991b) found that lead, zinc, cadmium and mercury above the expected background concentrations. Similar elevated concentrations were detected in a 20 cm sediment core sample (Christopher et al. 1993). The particle size analysis found 59.4 percent of the sediment was composed of silt and 26.4 percent was clay. This highly absorbing substrate plus the minimum current in the Pond cause the settling of contaminants. Mundy Pond sediment contains the highest heavy metal concentrations in the Waterford River Basin.

The sediment analyses for trace organic compounds identified numerous compounds. This site was collected in triplicate, and the results indicate non-homogenized samples. Alpha and gamma chlordane of the chlorinated hydrocarbon pesticides had maximum concentrations of 6.45 and 5.44 ng/g. Detection limits are 0.15 and 2.3 ng/g. Although these compounds are restricted, their slow transformation and breakdown result in their continued presence.

The maximum concentration of total polychlorinated biphenyls (PCB's) was 1140 ng/g and the minimum was 290 ng/g. This area had the highest concentrations of the survey.

Numerous PAH compounds were present, and because of the variation in concentrations, the data will be referred to in terms of concentration ranges. Of the seven compounds detected, only 2-methyl-naphthalene, phenanthrene and fluoranthene were found in all three samples. Acenaphthene and fluorene were found in 2 samples. Of the low molecular weight compounds, the maximum concentrations were found in phenanthrene (105 ng/g-1620 ng/g) and fluoranthene (227-2780 ng/g). These compounds are at the divisional line between low and high weight compounds and their characteristics are probably similar to high molecular weight compounds. The low weight compounds are more soluble and more volatile (CCREM 1987). Naphthalene ranged between 23.0 to 63.1 ng/g. and indicates a raw fuel presence. The source is likely urban runoff. The high molecular weight compounds are less soluble and strongly adsorb to particulate matter and biota (CCREM 1987). The high weight compounds present were pyrene, benzo(a)pyrene, endenopyrne and benzoperylene. Concentrations ranged between 145 to 2120 ng/g. The guidelines state a total concentration of 16 PAH compounds of 2000 ng/g "lowest effect level" and a 11 x 10^6 ng/g "severe effect level" (Persaud et al. 1992). Although the 16 compounds listed in the guidelines are not the

same as was those in this analysis, the Mundy Pond sediment exceeds the "lowest effect level" with only 1 to 3 compounds. Although Mundy Pond has been contaminated, the degree of impact is put into perspective when compared to Sydney Harbour sediment which contains PAH compounds in the range of 410,000 - 660,000 ng/g (Matheson 1983).

A forage fish sample was analysed for only metals (Table 8, Figure 20). The sample contained the lowest concentrations of the survey. Mercury was at 0.03 mg/kg which is below the 0.5 mg/kg guideline for edible fish. Copper and lead concentrations were 50 percent less than other sites, but remained higher than concentrations found in rivers influenced by mining in Newfoundland, Nova Scotia and New Brunswick (Bailey, 1988).

The zinc concentration of 43.1 mg/kg was below the 58.3 mg/kg at Donovan's tributary, but above the 12.0 mg/kg found at Red Indian Lake, Exploits River (Bailey 1988).

The last sample (ZM0074) was collected prior to mixing with the Waterford River. The 600 maximum countable level of faecal coliform, high nutrients and high heavy metals indicate an urban input. Copper concentrations are elevated to 0.007 mg/L, (0.002 mg/L guideline) , and zinc at 0.07 mg/L is double the guideline of 0.03 mg/L for the protection of freshwater aquatic life (Figure 15). Specific conductance increased to 1020 μSie/cm as a result of increases in all ions. The largest increases occurred in sodium and chloride (Figure 18). The ratio of Na:Cl remained at 1:1.8 indicating a sea water source. This area is 2 to 3 kilometres from the ocean and would be influenced by the salt water. An increase in alkalinity to 18.3 mg/L increased pH to 6.9, two units over the headwater sites (Figure 17).

3.24 **Waterford River above St. John's Harbour - ZM0093**

The final surface water sample was located 500 metres upstream of St. John's Harbour (Map 4). The prior site on the Waterford River was at Syme's Bridge, ZM0092.

Coliform levels were at the maximum 600 counts/100 mL. The phosphorus concentration rose to 0.18 mg/L as a result of the 1.5 mg/L phosphorus from the outfall pipe (ZM0097). Nitrate in the River decreased to 0.62 mg/L as a result of Mundy Pond's lower concentration. The 0.07 mg/L zinc concentration in Mundy Pond tributary (ZM0094) was diluted to 0.02 mg/L, as was the 0.007 mg/L copper, which measured 0.003 mg/L at the final River site. The copper and lead concentration from the South Side Outfall were also diluted to lower acceptable concentrations (Figures 14,15).

The specific conductance increased to 635 μSie/cm after the input from Mundy Pond Tributary which had a specific conductance of 1080 μSie/cm (Figure 18). The final alkalinity was 15.6 mg/L and pH increased to 6.9 pH units (Figure 17).

3.25 **St. John's Harbour ZM0104**

The last sediment sample was collected off a dock in St. John's Harbour (Map 4). This area of the Harbour is used for unloading freight ships, oil tankers, and as a dry docking facility. Field notes commented upon the area as having a "raw sewage odour" which would be from the numerous outlets for storm and sewage lines. The sediment consisted of 42.2 percent sand, 43 percent silt and 14.8 percent clay. The organic carbon content is 5-6 percent of the total weight, the second lowest of the survey. This substrate provided a low estimate of concentrations in the Harbour. Table 6 lists the results of the metal analysis. Roussel et al. (1991b) concluded that enriched levels of lead, zinc and mercury were present (Figure 22). Mercury concentrations in the Harbour (1.35 mg/kg) were the highest of the survey. The source of this is likely the adjacent sewage-storm outfalls.

The organic compound analyses are listed in Table 7. The results indicates a non-homogenized sample.

Compounds from four groups were detected; although, some were slightly above detection limits. The compounds; p,p-DDE and p,p-TDE are primary metabolites of DDT and were present in low concentrations. The only chlorinated hydrocarbons of significant concentration were PCBs at 903 ng/g. PCBs at concentrations of 1400-1600 ng/g have also been detected in St. John's Harbour (Roussel et al., 1991b), which reflects the varying concentrations throughout the Harbour. The source is likely from oil products used at the docks and urban runoff. Pentachlorophenol (PCP) was slightly above the 10.0 ng/g detection limit. Since this compound is used in wood preservation, the source could be from the wooden docks and other structures.

Fluoranthene was present in the sediment samples in concentrations which ranged between 7270-10100 ng/g. These concentrations can be considered extremely high since only 8 sites of 44 sampled near the Sydney Harbour tar ponds contained concentrations above the 10000 ng/g. Phenanthrene and Pyrene were the next highest at 7330.0 and 3890.0 ng/g. Only half of the sites in Sydney Harbour had concentrations this high. The carcinogen benzo(a)pyrene was measured at 2630 and 1400 ng/g. The highest concentration is double the 1000 ng/g guideline (IJC, 1983), and similar to 30 sites in Sydney Harbour. The other compounds are: fluorene, benzo(b)fluorene, benzo(k)fluorene, indeno pyrene and benzo perylene. Their concentrations range between 1000 to 2000 ng/g.

3.26 **Summation of the Waterford River Quality**

The Waterford River Basin is situated southwest of St. John's, Newfoundland. In August of 1989, most areas of the Waterford River provided suitable water quality for the protection of aquatic biota. The sources of impact were usually untreated sewage/stormwaters, effluents or emissions from industries and home, and NaCl leachate

from winter road de-icing operations (Figure 1). The Waterford River Basin receives NaCl from sea spray but numerous areas are beginning to experience higher concentrations of ions throughout the year. Over the past five years, the specific conductance and the concentrations of NaCl have gradually increased (Figure 13).

The headwaters are located in marshy lands south of the River. The major impacts are secondary roads and electrical power corridors. This area has high colour, DOC and an acidic pH (Figures 7-8).

Bremigan's Pond and Brazil Pond tributaries are the most westerly tributaries of the Waterford River. Bremigan's tributary flows from the southern marshy lands, and Brazil Pond tributary flows adjacent to Topsoil Road.

Bremigan's tributary, ZM0076, has been impacted by a dam and an adjacent electrical power corridor.

The dam has caused numerous variables to be elevated when compared to downstream flowing water. The preserved wooden electrical poles are a source of a pentachlorophenol leachate. Sediment below the dam (ZM0100) contained 215 ng/g PCP. Another impact is a sewage/storm outfall from a trailer park near the confluence with Brazil tributary (ZM0078). High coliform, nutrients and copper concentrations were found in the surface water (Figures 14,19). This source influences Brazil tributary (ZM0079). Elevated zinc on Brazil is expected to be from Bremigan's tributary (Figure 16). A sediment sample from Brazil Pond indicated low concentrations of biphenyls and elevated grease and oil percentages (ZM0101). The sources of these contaminates are lubricants and fuel runoff from the adjacent Topsoil Road.

These two tributaries form the Waterford River. The River flows a short distance before being joined by the northern Elizabeth Park Trailer Tributary (ZM0080). This tributary contains high coliform, nitrate and heavy metals which indicate a sewage outfall (Figure 19). The heavy metals: copper, zinc and lead, exceed the guidelines for the protection of aquatic life. The metals appear to settle before reaching the River (Figures 14,15).

Donovans Park tributary was sampled in the headwaters and at the confluence with the River. The headwaters (ZM0073) are located east of Bremigans Pond. Near the River, high coliform, nutrient and zinc concentrations indicate sewage input (Figures 15,19) (ZM0082). A forage fish sample from the lower site revealed low concentrations of PAH compounds and elevated copper and zinc concentrations (Figure 20).

The Waterford River then travels north of the residential areas of Glendale and the City of Mount Pearl. West of these areas the Glendale tributary flows into the River (ZM0004). This tributary contains elevated coliform, nutrient, copper and zinc concentrations (Figures 14,15,19).

Branscombes Pond tributary on the north side of the River is in close proximity to Topsoil Road and Empire Avenue (ZM0087). Although development is present, only nitrate is elevated.

Flings Brook headwaters (ZM0084) are located west of Mount Pearl. The data indicates a high coloured stream influenced by a newly exposed streambed (ZM0088). At site ZM0006, the coliform levels reach maximum counts. The source is either a outfall from the sub-divisions or runoff from the Experimental Farm. A sediment sample contained elevated zinc, six PAH compounds and 1,3-dichlorobenzene (ZM0084. Figure 22).

South Brook is the largest tributary. It is located south of Mount Pearl and north of Petty Harbour Long Pond. The headwaters are located in the southern marshy land from which Bremigan's Pond and Donovan's tributaries flow. As the Brook flows east, development along its perimeter increase and two tributaries with inferior water quality confluence with it. The tributaries flow from the area west of Petty Harbour-Long Pond. These tributaries (ZM0008, ZM0096) contain maximum coliform counts, elevated nutrient and heavy metal concentrations. At the confluence with the Waterford River, South Brook contains high coliform and nutrients (ZM0090).

Kilbride (ZM0009) is a long term collection site sampled under the Canada-Newfoundland Water Quality Agreement. The data indicates that the variables in the Waterford River are diluted by South Brook. Peaks in specific conductance come mainly from sodium and chloride in road salt. High metal concentrations are associated with discharge peaks which flush the sediment from the upper Waterford River Basin.

Below Kilbride, Beaver Brook merges with the Waterford River (ZM0095). The water quality is natural with high sea spray input. A sediment sample from Beaver Pond contained elevated PAHs (ZM0103).

Below Beaver Brook, an outfall pipe draining the subdivisions of Cornwall Height and Cornwall Crescent (ZM0097) contained elevated coliform, copper and mercury levels. Below this pipe is the outlet to Mundy Pond Tributary (ZM0074). The headwaters are natural with an pH of 5.0 units and a low alkalinity (Figure 7). The headwaters drain into Mundy Pond which is located near the centre of the City. A sediment sample (ZM0102) from the Pond contained elevated concentrations of lead, zinc, cadmium, mercury and PCB's and the PAH's; phenanthrene, pyrene and fluoranthene. Sample ZM0094 was collected at the outlet. It contained elevated concentrations of coliform, nutrients, copper and zinc (Figures 14,15,19).

The final surface water sample was collected above St. John's Harbour (ZM0093). This sample contained maximum coliform counts, and below guideline heavy metals concentrations. A sediment sample was collected at the Harbour (ZM0104). It contained elevated lead, zinc, mercury, polychlorinated biphenyls (PCBs) and PAHs.

The aquatic quality of the Waterford River Basin has degraded since the 1985 Hydrology Report (Arseneault et al. 1985) as a result of the input of raw sewage and the leachate of road salt. In 1985, the sodium and chloride concentrations were concluded to be 10 times lower than the 250 mg/L, and 270 mg/L drinking water guidelines and "not of great concern". In 1989, the concentrations of these ions continued to steadily increase, with median concentrations of 60 mg/L (Na^{++}) and 96 mg/L (Cl^{-2}), and maximum concentrations of 383 mg/L and 615 mg/L.

The input of sewage has also increased causing coliform to be elevated throughout the basin. Nitrate concentrations are also elevated and total nitrogen has increased from 0.5 mg/L to 0.7-1.0 mg/L. Phosphorus concentrations have decreased, but this is a result of lower concentrations in consumer goods.

4.0 Quidi Vidi Lake System

Quidi Vidi Lake is located 1 kilometre north of St. John's Harbour. The lake receives water from Leary's Brook-Rennie's River to the east and Virginia River to the north. The lake flows into Quidi Vidi Harbour. This system like the Waterford River System flows through the City of St. John's, and is subjected to the impact of development (Maps 6,7). Four months prior to the August 1990 survey, water samples were collected to obtain short term temporal water quality data of the least impacted headwater areas. These headwater sites were:

Leary's Brook - Rennie's River System (Map 6):

00NF02ZM0046: Yellow Marsh Brook, 750 metres north of Kenmount Road

00NF02ZM0042: Leary's Brook, 750 metres north of Thorburn Road and above Carty's Stream confluence

00NF02ZM0070: Nagle's Brook, 1.5 kilometres northwest of Long Pond

Virginia River (Map 7):

00NF02ZM0098: Virginia River, 500 metres south of Portugal Road - Penetanguishene

Long-term water quality data was available for the following three sites from the present Canada-Newfoundland Water Quality Agreement:

00NF02ZM0016: Rennie's River: above inlet to Quidi Vidi Lake (Table 18)

00NF02ZM0014: Virginia River: 30 metres upstream of Quidi Vidi Lake (Table 19)

00NF02ZM0015: Quidi Vidi Lake Outlet (Table 20)

The water quality of this basin will be discussed from the headwaters to the Harbour. Water quality will be assessed with subsequent description of the various tributaries to the Quidi Vidi system.

4.1 Headwater Sites

The geology of the Quidi Vidi System is similar to that of the Waterford River basin. The geological groups of the Avalon Peninsula are located in northeast to southwest linear bands. The headwaters overlies the geology of the Conception Group, which is composed of the Torbay and Drook Formations. The Torbay Formation is considered an extension of the Mistaken Point Formation. Towards the Harbour, the geology changes to the Signal Hill Group which is composed of the Blackhead, Flat Rock Cove, Cuckold,

Cape Ballard, Quidi Vidi and Ferryland Head Formations. (King 1984) The surficial geology is composed of thin vegetated till with numerous rock outcrops and small organic deposits.

The water quality data collected at the headwater sites are listed in Table 12. To relate the water quality and the water quantity data, the daily discharge (cms) from Environment Canada's hydrometric gauge stations will be used. One gauge (ZM019) is located on Virginia River above the golf course and near site ZM0148. The other gauge is on Leary's Brook (ZM020) above Long Pond and site ZM0138 (Maps 6,7).

The headwater sites have similar water quality characteristics. The April samples were the most acidic of the spring period at 4.9 to 5.4 pH units. The acidity was from winter snow thaw and a depressed alkalinity of -0.3 to 0.2 mg/L (Figures 23,26).

The sodium and chloride concentrations increase with each rain event and are the major influence on specific conductance. The Na:Cl ratio of 1:1.5 suggests a road salt source (Figure 36). In the winter of 1989, St. John's used 41,830 tonnes of road salt. This is an increase of up to 28,800 tonnes over past years (Figure 1). The salt accumulates in the soil and with each rain event, leaches into the basin.

In summer during low discharge, silica, calcium, magnesium, iron and manganese become the major variables (Figure 25). These concentrations are reflected in an increased alkalinity (2.5 to 3.9 mg/L), and pH (6.1 to 6.3 pH units).

During the sample period, specific conductance fluctuated slightly (Figure 24) because the spring's sodium, chloride and sulphate concentrations are replaced by calcium, magnesium and DOC. Nutrients are stable throughout the year and heavy metals are below the guideline for the protection of aquatic life (CCREM, 1987).

4.2 Leary's Brook ZM0042

Leary's Brook flows from the headwater north of Thorburn Road to Long Pond on the University Campus. From Long Pond to the Quidi Vidi Lake, the water course is known as Rennie's River (Map 6).

Headwater site ZM0042 is located 750 metres north of Thorburn road and upstream of a hydropower transmission line. Coliform counts indicate the absence of storm/sewage outfalls (Table 13). This sample was collected in August during low discharge. The slight increase in sodium and chloride but not sulphate suggest a road salt leachate. Calcium and magnesium create an alkalinity of 2.5 mg/L, and a pH of 6.5 units (Figures 29,30). The increases of iron and manganese over prior months (Figure 31) increase colour to its maximum value of 70 relative units.

4.3 Carty's Stream Tributary ZM0128

Leary's Brook flows 0.5 kilometres to Juniper Ponds. At the north end of the Pond is the 2.0 kilometre Carty's Stream which drains the northern area. The collection site is located above Grove's Road and the Pond. The low coliform and heavy metal concentrations indicate that the area is void of storm and sewage outfalls. An increase in calcium and magnesium are reflected in a increased alkalinity. A lower iron and DOC are reflected in a colour value of 10 relative units.

4.4 Leary's Brook below Juniper Pond ZM0136

In a stillwater at the outlet of Juniper Pond, a triplicate sediment sample, ZM0136, was collected for organic compounds and metal analysis. The consistency of the data indicates a homogenized representative sample. The particle size analyses indicate a consistency of 67.8 percent sand, 15 percent clay and 15 percent silt. The high sand content is not the optimum substrate for metals and trace organic adsorption.

Table 16 lists the results of the organic analysis. 3,4-trichlorophenol was present at a maximum concentration of 2.3 ng/g, 2,4,6-trichlorophenol at 1.7 ng/g and pentachlorophenol (PCP) at 2.6 ng/g. These concentrations are slightly above their detection limit and the probable source is the electrical powerlines 0.5 kilometre upstream. PCP is commonly used as a wood preservative on poles for power lines. The other two compounds are often present as additives in the wood preservative.

The sediment-metal analysis (Table 15) were interpreted using a metal to aluminum ratio technique to determine if a metal was anthropogenically enriched (Roussel et al. 1991b). Each toxic metal was quantified in relation to a ratio with the reference metal aluminum. The only metal detected as being enriched was lead. The concentrations ranged between 16.1 to 17.7 mg/kg which are below the lowest effect level guideline of 31 ng/g (Persaud, et al., 1992). The source is likely from leaded fuels.

4.5 Leary's Brook below Thorburn Road ZM0127

Site ZM0127 was collected 500 metres below Juniper Ponds (Map 6). This location is 100 metres above Thorburn Road and the area is developed. Coliform count at this site increased 20 fold (Table 13). Although still below guidelines for recreational use, it indicates storm/sewage outfalls. Heavy metal concentrations are below detection limits, and phosphorus and specific conductance increase slightly.

A surface water sample was analysed for organic compounds (Table 14). Only 1,4 and 1,2-dichlorobenzene were found and these are known contaminants (Section 6.3).

4.6 **Oxen Pond Tributary ZM0129, ZM0137**

Leary's Brook flows under Thorburn Road and continues for 1 kilometre into Wigmore Pond. To the north of Wigmore Pond is Oxen Pond Tributary. The east side of Oxen Pond is developed but the low coliform count in the stream suggest the absence of sewage outfalls (ZM0129). There may be storm outfalls since phosphorus doubled in relation to background concentrations (Figure 28). The major ion concentrations are similar to the Carty's stream and a low iron and DOC content produce a colour of less than 5 relative units.

Half a kilometre upstream of site ZM0129 is Oxen Pond. The Pond is 500 metres in diameter and located within 200 metres of Oxen Pond Road. At the Pond's outlet, a triplicate sediment sample was collected (ZM0137) and analysed for organic compounds and metals. The results of the triplicate sample indicate a homogenized sample. The organic analysis, (Table 16), show 6 compounds above detection limit concentrations. Two PAH's were present and their maximum concentrations were; pyrene; 28.8 ng/g, and fluoranthene 82.4 ng/g (detection limit 15 ng/g). The PAH concentrations are acceptable since background levels in the Atlantic Region are 10-20 ng/g. 2,3,6-trichlorophenol was detected slightly above its detection limit, whereas 3,4-dichlorophenol, 2,4,6-trichlorophenol and pentachlorophenol were similar to concentrations found at Juniper Ponds.

The source of the 2.9 ng/g pentachlorophenol is likely power poles along Oxen Pond Road. The other compounds are used in herbicides and wood preservative additives.

The metal analysis detected 23600 mg/kg of aluminum which was the highest found in the Waterford-Quidi Vidi basin and six times that of Juniper Ponds. The iron concentrations were the lowest of the survey at 4570 mg/kg (maximum), and similar to concentrations found 4 kilometres north-east in Virginia Lake. The metal/aluminum ratio indicated that all metals could naturally occur (Figure 35).

4.7 **Leary's Brook Below Wigmore Pond ZM0125**

Leary's Brook was resampled below Wigmore Pond and above Yellow Marsh Stream. The high run-off from August 6th caused a large increase in total coliforms, whereas, faecal coliform counts decreased slightly. Specific conductance doubled from 78 μSie/cm to 130 μSie/cm as a result of an increase in all ions. Alkalinity increased from 3.8 to 5.0 mg/L and pH remained at 6.7 units.

Nitrate-nitrite was elevated and the source is likely runoff from surrounding lawns (Figure 28).

4.8 **Yellow Marsh Tributary ZM0046, ZM0123**

Yellow Marsh Stream originates between Thorburn Road and the Trans Canada Highway (Route #1), west of Leary's Brook. Approximately 1.5 kilometres upstream from the confluence, Yellow Marsh stream branches to the north and south. The south Branch flows along Highway #1 for 2 kilometres. The north Branch travels west 2 kilometres originating in undeveloped land. Each branch of Yellow Marsh was sampled 5 metres upstream from the confluence.

The north branch site (ZM0046) is a clear, low turbidity waterbody. Spring and winter thaws decrease the alkalinity, and pH drops to 5.3 pH units. In summer, decreased precipitation and discharge is reflected in higher alkalinity and pH values.

The South Branch (ZM0123) is influenced by development and the TransCanada highway. Total coliforms increase to 50000/100 mL and faecal coliform levels increase to 500/100 mL, which is above the 200/100 mL recreational guidelines (CCREM 1987) (Table 13). During high runoff sodium, chloride and sulphate concentrations increase with the Na:Cl ratios indicating a road salt influence. Specific conductance measured 430 μSie/cm as compared to 40μSie/cm for the north branch. The storm/sewage input contributed to a high phosphorus of 0.27 mg/L and nitrate/nitrite of 0.59 mg/L. Copper (0.003 mg/L) and zinc (0.05 mg/L) exceeded the guidelines for protection of freshwater aquatic life.

The analysis of a surface water sample for organic compounds indicated that all compounds were below the analytical detection limit (Table 14).

4.9 **Yellow Marsh Stream - Main Branch - ZM0126**

Yellow Marsh stream was sampled 5 metres above the confluence with Leary's Brook. The water quality of Yellow Marsh stream indicates that the North Branch dilutes the South Branch variables. Calcium, sulphate and silica concentrations increased in relation to both branches, which suggest a ground water input. The calcium-carbonate increase is reflected in the increased alkalinity and pH of 6.4 units (Figure 30). Phosphorus decreased to 0.027 mg/L and faecal coliform dropped to 1200/100 mL (Figure 28). The zinc concentration remained above the guidelines at 0.05 mg/L (Figure 32).

4.10 **Leary's Brook Below Yellow Marsh Stream Confluence ZM0124**

Leary's Brook was sampled 20 metres below the confluence with Yellow Marsh Stream (Map 6). This site is below an unidentified outfall pipe and feed-mill. The faecal coliform count had increased to 3400/100 mL from 1200/100 mL at the sites above which sugest the pipe is a storm-sewer outlet (Figure 28). Nutrient concentrations remained

similar and other variables decreased which suggest a dilution by the low concentrations of variables in Leary's Stream.

An analysis of the surface water for organic compounds indicated that all compounds were less than detection limits.

4.11 Leary's Brook below Thorburn Road ZM0130

Leary's Brook flows south for 300 metres before turning northeast into an 0.5 kilometre underground tunnel. The Brook then flows along Prince Phillip Drive (Map 6). This area is highly commercialized and is the point of intersection for the city's major streets. The higher total coliform level and lower faecal coliform count is attributed to the increase in soil coliform population. Specific conductance and alkalinity increased, which is attributed to the input of calcium, magnesium and sulphate (Figure 29).

An analysis for organic compounds found 1 and 2 methylnaphthalene, and total polychlorinated biphenyls (PCB) above their detection limits. The first two compounds are low molecular weight polynuclear aromatic hydrocarbons. The detection limit of each is 10.0 ng/L and these were present at 23.6 and 20.8 ng/L. Their source is most likely from adjacent roads and shopping mall parking lots. The naphthalene compounds are commonly used in motor lubricants and fuels. The 12.3 ng/L of PCB's are likely from electrical transformers. The guideline for Total PCB's for the protection of freshwater aquatic life is 1.0 ng/L (CCREM, 1987); hence, the concentration is expected to be detrimental to the aquatic community. The percent recoveries for PCB's in the quality control samples (Section 6.3) were between 79 and 107 percent. These recoveries indiciate that the measured concentration is representative. Because the PCB's are present in the watercolumn, the source is likely present and continuous.

4.12 Leary's Brook Along Prince Philip Drive ZM0138

Leary's Brook flows 2 kilometres along Prince Phillip Drive and into Long Pond located on Memorial University Campus. During construction of the campus, Leary's Brook was re-routed. Originally, the streambed flowed in an eastern semicircle, but the present route is to the west before entering Long Pond (Map 6). This area of St. John's is newer and the data suggest that the infrastructure does not empty into the Brook. Faecal coliform in relation to upper sites decrease from 2300 to 800/100 mL and total from 15800 to 5000/100 mL. A similar decrease was observed in phosphorus, but nitrate concentrations increased which suggest a runoff of lawn fertilizers along Prince Phillip Drive and the campus. An increase in specific conductance from 320 to 480 μSie/cm is a result of an increase in all ions. The ratio of sodium to chloride indicates a road salt source and exposed bedrock appears to be the source for the increased calcium and sulphate concentrations.

The analysis of the surface water for organic compounds were similar to site ZM0130 (Table 14). The PCB concentration increased slightly from 12.3 ng/L to 19.0 ng/L, and 1,2,3,4-tetrahydronaphthalene was present at the detection limit. The ubiquitous alpha-BHC was detected for the first time in the Quidi Vidi watershed and the analytical contaminant, 1,4-dichlorobenzene, was present at 32.5 ng/L, the highest of the survey.

A forage fish sample (ZM0138) was analysed for only metals (Figure 34). Mercury was at the guideline for edible fish (0.5 mg/kg)(IJC, 1976), and 1.76 mg/kg of copper was higher than that found in Red Indian Lake, Exploits River, and equivalent to the concentration found in the Mira and Salmon Rivers in Nova Scotia (Bailey 1988). Zinc at 39.9 mg/kg was above the 12.0 mg/kg concentration found in Red Indian Lake, but below the 81 mg/kg concentration found in New Brunswick's Tomogonops River.

Elevated zinc, copper and lead concentrations were detected in the sediment 800 metres downstream in Long Pond (Section 4.14). Because of the high metal concentration in the forage fish and in the Pond's sediment, the sediment from this area is likely enriched with metals. The presence of PCB's in the aquatic life is also highly probable (CCREM 1987).

4.13 **Tributary of Nagle's Hill Brook ZM0070, ZM0131**

Nagle's Brook is a 2.5 kilometre tributary north of Long Pond. The Brook originates from three ponds located north of Oxen Pond: Big, Middle and Left Pond. The Brook flows south-east through the City's Pippy Park. Two sites were selected for sampling. The headwater site ZM0070 is located 1.75 kilometres upstream of Long Pond.

The headwaters are surrounded by the Windsor Lake, Virginia River and Leary's Brook headwaters. Deposits of organic material are located throughout the area and are reflected in the high DOC (7.6 mg/L). The sample was collected on August 08, when the discharge was decreasing from the August 06 rain event (Figure 5). A turbidity at the headwater site of .60 JTU as compared to the lower site's value of 0.35 JTU is a result of the storm's runoff. The low major ions concentrations are reflected in the low alkalinity, specific conductance and pH. Nutrients and coliform concentrations are low which indicates the absence of storm and sewage outlets.

Approximately 1.0 kilometres downstream, site ZM0131 was collected as a triplicate sample. This area is in Pippy Park. The absence of organic deposits cause the DOC to drop from 7.6 mg/L to <.5 mg/L. The low coliform and phosphorus concentrations indicate the absence of sewage. Nitrate increased to 2.0 mg/L in comparison to the headwater concentration of <.01 mg/L. The probable source is runoff from the Park. As the surficial geology changes to thin rocky till and roads approach the Brook, an increase in major ions occurs. The Na:Cl ratio indicates a road salt leachate.

4.14 Long Pond Sediment ZM0134, ZM0139

Long Pond is located on the west side of the University Campus (Map 6). The Pond receives water from Leary's Brook and Nagle's Brook. It is bordered to the east by Prince Phillip Drive and to the west by Pippy Park.

Two sediment samples were collected in Long Pond. Site ZM0134 was located 100 metres below the inlet of Leary's Brook. Site ZM0139 was located 10 metres below Nagles Hill Brook inlet. The samples were collected in triplicate and analysed for organic compounds and metals. The particle analysis of site ZM0134 (Table 15) shows a high percent of silt (70 percent) and clay (18 percent) and a lower amount of sand (12 percent). The lower site, ZM0139, contains a high percentage of sand (40 percent) and a lower silt content (35 percent). The sediment composition of site ZM0134 should provide a better substrate for the adsorption of trace organics and metals.

The organic compounds analysis of ZM0134 show that all groups, except the organochlorines, were detected (Table 16). The organochlorine pesticides have been deregistrated and they are rarely found in the province. Of the detected compounds only the PCBs were above "lowest effect level" (Persaud, et al., 1992)

The concentration of PCB's ranged between 30700 to 52400 ng/g. The highest concentration at Mundy Pond, the site of a former asphalt plant was 1140 ng/g. Although these concentrations appear high, a "severe effect level" is not reached until 530,000 ng/g, and the lowest effect level is at 70 ng/g (Persaud, et al., 1992).

Approximately 1 kilometre down the Pond, site ZM0139 was collected 10 metres from Nagles Brook. The PCBs concentrations in relation to site ZM0134 have decreased ten times, ranging between 2110 ng/g to 3580 ng/g. This lower concentration is probably the result of sediment movement.

Sample ZM0139 also contained chlorinated phenols (CP) and PAH compounds. Most CPs were at their detection limit but pentachlorophenol (PCP) ranged between 8.3 to 18.3 ng/g. This is a decline from the concentrations found at the head of the Pond. The lower concentrations suggest a settlement of the compound between the two sites. A marine guideline (MacDonald, et al., 1992) list a concentration of less than 140 ng/g in which a significant biological effect is observed. The concentration at this site should not be detrimental to the benthic community.

The PAH concentrations were the highest found in the Quidi Vidi Survey. The sample was not homogenized because one of the three samples contained concentrations 3 to 4 orders of magnitudes greater. A possible source would be the boiler located within a kilometre on the University campus. Stack emissions would be blown east, and the settlement of particles would be over the Pond. Many of the compounds exceed concentrations found in Mundy Pond, but are similar to the minimum

concentration found in the St. John's Harbour. Three of the 7 low molecular weight PAH compounds were present at the upper site (ZM0134). The other four compounds were naphthalene congeners, acenaphthene and fluorene. The concentrations were below the guidelines, and their presence at the lower site is a result of their solubility and lower affinity for surfaces. The low molecular weight PAHs phenanthrene and fluoranthene had maximum concentrations of 1150 ng/g and 1550 ng/g. These are higher than at the upper site and the greater solubility and flocculation is the probable reason for the difference. The low molecular weight PAH's are below the Marine Guidelines of 1800 ng/g for dredge disposal and 6100 ng/g for lethal apparent effect threshold (MacDonald et al., 1992). A similar pattern was observed with the high molecular weight PAH compounds. The higher concentrations of these suggest that site ZM0139 is a point at which sediment accumulates. The factors influencing deposition may be current, rate of adsorption and an optimum settling environment. The PAH concentrations are below the listed apparent effects thresholds and dredge disposal concentrations. The only PAH recognized for its carcinogenic effect is benzo(a)pyrene. This compound was present at 351-688 ng/g, which is below the 1000 ng/g guideline for the protection of freshwater life (IJC, 1983).

The metal analysis at the two sites indicate enrichment at both. Each sample was collected as a triplicate and results indicate homogenized sample. At site ZM0134, the zinc concentrations ranged between 725 and 308 mg/kg. At site ZM0139, chromium concentrations ranged between 4.59 and 15.7 mg/kg. The 15.7 mg/kg should be considered with caution. Both sites indicated enriched concentrations of copper, lead and zinc, and site ZM0139, opposite Nagles Brook, contained elevated concentrations of nickel. These metals were also elevated in Kents Pond's sediment, ZM0135, which is 1 kilometre north.

Lead concentrations in the Pond ranged between 260 to 334 mg/kg. These concentrations are enriched and are above the "severe effect level" guidelines of 250 mg/kg (Persaud, et al., 1992) and above the major biological effects concentration of 130 mg/kg (MacDonald et al., 1992). Lead concentrations of 5 to 10 times these concentrations were found in a geochemical survey of the area surrounding St. John's (Christopher et al., 1993). Maximum zinc concentrations were 631 to 677 mg/kg. These concentrations are below the 820 mg/kg guideline for "severe effect level" (Persaud et al., 1993). Bailey (1988) found zinc concentrations to range between 680 to 1170 mg/kg in Red Indian Lake, Exploits River, and Mundy Pond contained zinc at 1160 mg/kg. Copper ranged between 42 to 54 mg/kg. These concentrations are below the 110 mg/kg guideline for "severe effect level", but above the 16 mg/kg guideline for "lowest effect level" (Persaud, et al., 1992). The heavy metal concentrations in Long Pond should be detrimental to the sediment dwelling community.

4.15 **Rennie's River - Outlet Long Pond ZM0133**

Rennie's River flows from Long Pond through the oldest sections of St. John's. The River is crossed by numerous streets and is surrounded by development. Rennie's River was sampled below the Long Pond outlet.

The coliform counts from Leary's Brook; (faecal 800, total 5000) were reduced to total 80 and faecal 10/100 mL. A similar reduction occurred with the other variables.

An analysis for organic compounds found 20.1 ng/L of total PCB's. The guideline for PCB is 1.0 ng/L (CCREM, 1987). The percent recoveries of the PCB's quality control samples were between 77 and 107 percent. The analytical contaminant 1,4-dichlorobenzene, was also detected (Section 6.3).

As this system flows towards Quidi Vidi Lake the geology changes from the Mistaken Point Formation (Conception Group) to the Trapeze Formation (St. John's Group), and then to the St. John's and Signal Hill Groups.

4.16 **Kent's Pond Tributary ZM0132, ZM0135**

Kent's Pond tributary enters Rennie's River 100 metres below Long Pond. The tributary flows from a west branch which originates near the Pippy Park Campground, and the east branch which originates in Kent's Pond. A surface water sample was collected above the confluence with Rennie's River (ZM0132). The coliform and nutrient levels indicate the absence of sewage-storm input (Figure 28). A specific conductance of 1000 μSie/cm is a result of large increases of all major ions, especially sodium and chloride (Figure 29). The geological ions are likely the result of newly exposed rock, but the sodium and chloride indicates a salt water source. An increase in alkalinity resulted in an increase in pH to 6.9 units (Figure 31). The exposed bedrock also provided higher concentrations of manganese and iron.

A sediment sample from the outlet of Kents Pond (ZM0135) was analysed for metals and organics (Tables 15, 16). The sample consisted of 54.8 percent silt and 30.6 percent clay. Numerous PAH compounds were present at concentrations of 33 ng/g to 148 ng/g. If the source of emission were near the Avalon Mall area, the heavier particles would settle into Long Pond and the lighter particles would travel to Kents Pond and surrounding area. Pentachlorophenol ranged between 2.2 to 4.0 ng/g, and other chlorophenols were present in low concentrations.

The metals data found enriched concentrations of copper, nickel, lead and zinc (Figure 35). The source may be similar to that of the organic compounds. Kent's Pond contains similar concentrations of metals as were found in Long Pond, except for nickel, which shows a slight increase. Zinc values were lower at 462-485 mg/kg when compared

to Long Pond of 631-737 mg/kg. These metal concentrations may produce a detrimental effect to the benthic community (Persaud, et al., 1992).

4.17 **Kelly's Brook Tributary ZM0144**

Rennie's River flows 1.5 kilometres through the City before joining with Kelly's Brook (Map 6). This Brook flows through the midst of old St. John's, and the headwaters are located south of the University Campus. This older residential area has a poor sewage infrastructure and maximum coliform counts and elevated nutrient concentrations indicate the presence of storm/sewage input.

Due to bottle breakage, the surface water was analysed for only the chlorinated phenols. All compounds were below their detection limits (Table 16).

4.18 **Rennie's River Canal Park ZM0145**

Downstream of the Kelly's Brook and 250 metres above Quidi Vidi Lake, Rennie's River was sampled at Canal Park (Map 6). The sample was collected on August 14th. The discharge gauge at Prince Phillip Drive indicated that the flow increased from 0.12 cms to 0.60 cms (Figure 5). The expected results would be increased runoff and dilution. The output from the storm-sewage lines caused coliform values to exceed the 600/100 mL maximum count. Specific conductance increased to 820 μSie/cm as a result of the 1000 μSie/cm from Kent's Tributary. Calcium, potassium, sulphate and silica increased over the Kent Pond input suggesting additional ground water (Figure 29).

4.19 **Rennie's River above Quidi Vidi Lake ZM0016**

Rennie's River has been sampled monthly since 1986 above Carnell Drive Bridge as part of the Canada-Newfoundland Water Quality Monitoring Agreement. A significant feature is the large winter peak in specific conductance as a result of road-salt (Table 18, Figure 36). The use of salt over the past winters is influencing the water quality throughout the year.

The River is lightly coloured reaching 30 relative units during low flow (Figure 37). Calcium and silica concentrations were higher in January-February, because of a greater ground water influence and lower dilution during snow cover. The concentrations of heavy metals followed the hydrologic events and indicate that the higher concentrations are a result of the resuspension of bound particles. Zinc and copper concentrations reached 2 to 3 times the aquatic life guidelines (CCREM, 1987) during the four year period (Figure 39).

The organic compound analysis found PCBs below their analytical detection limit (9.0 ng/L). The contaminant 1,4-dichlorobenzene, the ubiquitous alpha-BHC, and 1,2,4-trichlorobenzene were also detected. Although this is the only site at which

1,2,4-tCB (4.6 ng/L) was above the 1.0 ng/L detection limit, the concentration is below the 500 ng/L guideline (CCREM, 1987). A percent recovery for 1,2,4-tCB was between 68 and 101 percent. The source of this chlorinated benzene is likely urban run-off.

A forage fish sample was analysed for organics and metals (Table 17). The organic analysis detected PCBs and the chlorinated hydrocarbon; dieldrin. The PCB concentration of 1160 ng/g is likely a result of bioaccumulation between Long Pond and Quidi Vidi Lake. Dieldrin was present at 6.33 ng/g. This concentration is questionable because of the uncertainty which exists with quantifying organics near their detection limit and also Dieldrin was also banned years ago (Richard Martin, NFDOEL, personal communication). Mercury (0.12 mg/kg) was below the 0.5 mg/kg guideline, whereas lead and copper were four times the concentrations found in streams influenced by mining (Bailey, 1988). A zinc concentration of 49 mg/kg was four times the 12 mg/kg concentration at Red Indian Lake, Exploits River, but half the 81.0 mg/kg found on the Miramichi River in New Brunswick (Bailey 1988).

4.20 **Virginia River ZM0098**

The Virginia River System lies north-west of Quidi Vidi Lake and directly north of the Leary's Brook - Rennie's River System (Map 7). The system is approximately 8 kilometres long with Virginia Lake located at the midpoint. The headwaters are located south of Windsor Lake. To the north and east of this system are the subdivisions of Penetanguishene and Rickett's Bridge. The geology consist of the Drook Formation with a surficial geology of vegetated and stony till interspersed with organic deposits.

Samples from the headwater site, ZM0098, were collected four months prior to the August survey (Table 12). In April, when the runoff is high, geological major ions are diluted. The higher concentrations of sodium and chloride indicate a major road salt source and a minor sea spray source. As precipitation decreases, the Na:Cl concentrations remain stable, and indicate a road salt leachate. The diluted geological ions are reflected in the decreased alkalinity and pH. During low discharge, an increase in major ions are associated with an increase of alkalinity (0.1 mg/L to 3.7 mg/L) and pH (5.0 to 6.3 pH units). The increase in color and turbidity is attributed to an increase in iron and manganese. Coliform counts indicate the absence of storm/sewage input.

4.21 **Virginia River above Torbay Road ZM0143**

Three kilometres east, Virginia River was sampled above Torbay Road. Since the last site, the River has travelled through Rickett's Ridge, and along Torbay Road. Although impact is expected the coliform counts at site ZM0143 indicate the absence of sewage input. A large increase in all the ions except sulphate, is attributed to ground water input. The sodium to chloride ratio of 1:1.8 indicates a salt spray origin. The ocean lies 3.4 kilometres east. A lower DOC and increased alkalinity increases pH to 7.0 units (Figure 30).

The lower concentrations of iron and manganese (Figure 31) are reflected in the colour.

4.22 **Virginia River above Virginia Lake ZM0141**

From site ZM0143, the River flows adjacent to Torbay road for 250 metres before bending east to Virginia Lake (Map 7). The coliform, nutrient and heavy metals indicate a storm/sewage input. Faecal coliform increased from 40 to 1000/100 mL, phosphorus doubled and nitrate quadruples from 0.17 to 0.95 mg/L. Copper was at the 0.002 mg/L detection limit and zinc increased three times the 0.03 mg/L guideline (CCREM, 1987) (Figure 34). The geological metals increase slightly and the specific conductance increased from 237 to 500 mg/L. The increase of sulphate to 14.75 mg/L appears to from a geological source ($CaSO_4$) since the correlation of sulphate to calcium is R=0.649 and R=0.798 at sites ZM0014 (Virginia River outlet) and ZM0016 (Rennies River outlet).

4.23 **Virginia Lake ZM0140**

Virginia lake is approximately 330 metres wide by 1 kilometre long. It is situated 2.5 kilometres north of Quidi Vidi Lake between Torbay Road and Logy Bay Road. To the south and west of the lake are subdivision developments. To the east, a few scattered buildings are located along the shoreline.

A sediment sample was collected 20 metres below the inlet. The triplicate sample was analysed for metals and organic compounds (Tables 15,16) and indicate a homogenized sample. The consistency of the sediment was 56 percent sand, 33 silt and 11 percent clay. The large portion of sand should contain lower concentrations of compounds in comparison to areas which contain more silt and clay. Numerous PAH compounds were detected at twenty-five percent of the concentrations found in Long Pond. The greater concentration of compounds in comparison to Kents Pond is probably due to the larger catchment area. Benzo(a)pyrene measured 534 ng/g (maximum value), which was below the 1000 ng/g guideline (IJC, 1983). Numerous chlorinated phenols were present at the detection limit or slightly above. The maximum concentration of PCP was 12.0 ng/g which is half the 25 ng/g concentration found in Long Pond. The source of the chlorinated phenols is likely wood preservative on utility poles. The other compounds detected were total polychlorinated biphenyls. The maximum concentration of PCB's were 417 ng/g which is 100 times less than the concentration found in Long Pond, but above the 70 ng/g "lowest effect level" guidelines (Persaud et al., 1992).

The metal analysis from Table 15 indicate that copper, zinc and mercury concentrations are enriched (Figure 35). The concentrations of copper and zinc are twenty-five percent of those found in Long and Kents Pond. The mercury maximum concentration of 0.39 mg/kg is below the 2 mg/kg "severe effect level" guideline, but above the 0.2 mg/kg guideline for the "lowest effect level" (Persaud, et al., 1992). The mercury concentration is similar to the lowest mean values found in Red Indian Lake, and

Exploits River (Bailey, 1988). Mercury containing pesticides have been restricted in Canada since 1979-80, therefore other possible sources would be past contaminated sediment, atmospheric deposition, geological sources or batteries.

4.24 Virginia River Below Lake ZM0142

The water quality leaving Virginia Lake was assessed 10 metres below the outlet. Coliform counts entering the lake were 26000/100 mL for total and 1000 for faecal. At the outlet, they were 180 for total and 10 for faecal. These decreases indicate that Virginia Lake receives minor inputs of sewage. Ground water has less influences in the lake since silica concentrations drop from 6.4 mg/L to 0.88 mg/L and calcium and alkalinity dropped from 14.6 mg/L to 10.9 mg/L. The large decrease in silica may also be due to algal growth. The sodium:chloride ratio above the lake indicated salt spray influences, whereas at the outlet the ratio indicates road salt influences. The lake probably receives high quantities of road salt during winter road operations, spring run-off, and from soil leachate. Iron and aluminum concentrations decreased by 50 percent whereas manganese remained stable reflecting the Mistaken Point Formation influence. All heavy metals were below detection limits.

The organic compound analysis found the ubiquitous alpha and gamma BHC compounds at detection limit, a quantity of 1,4-dichlorobenzene from analytical contamination, and 11 ng/L of polychlorinated biphenyls. The concentration of the PCB is 11 times the 1.0 ng/L guideline (CCREM, 1987), but only slightly above the detection limit of 9.0 ng/L. The percent recovery for PCB is near 100 percent (Section 6.3).

4.25 Fagan Drive Tributary ZM0146

One hundred and fifty metres below site ZM0142, Virginia River if joined by an underground tributary which originates west of Torbay Road. The maximum count of coliform and nutrients indicate a sewage-storm input. These variables remain at maximum concentrations throughout the remainder of Virginia River (Figure 28). A silica concentration of 8.6 mg/L and a high concentrations of major ions and geological metals indicate a large ground water input.

4.26 Tributary Above Golf Course ZM0147

Downstream of tributary ZM0146, Virginia River is joined by tributary ZM0147 (Map 7). A triplicate surface water sample was collected 100 metres upstream of Logy Bay Road. The catchment area is developed and sections of the stream are underground. Sewage- storm outfalls are expected to enter the stream since coliform is at the 600/100 mL maximum count, phosphorus increases to 0.05 mg/L and nitrate doubles to 2.6 mg/L. The specific conductance is the highest of the survey at 1020 μSie/cm. This value is a result of high concentrations of calcium, sulphate, sodium and chloride (Figure 29). The sodium to chloride concentrations indicate a sea spray origin. Alkalinity increases and

pH remains at 6.8 pH units. The geological metals concentrations are lower than those in the above tributary, and manganese remains the dominant metal (Figure 31). Zinc and copper concentrations are the highest of the survey with zinc at 0.11 mg/L and copper at 0.006 mg/L. Each value is 3 times above the water quality guidelines (CCREM, 1987) (Figures 32,33).

4.27 **Virginia River Below Logy Bay Road ZM0148**

Site ZM0148 was below Logy Bay Road, and north of the Golf course. The River follows the golf course for approximately 1 kilometre before descending the last half of a kilometre into Quidi Vidi Lake. The data indicate that the high concentrations of variables from the lower tributary (ZM0147) were diluted by Virginia River. In comparison to Virginia Lake outlet (ZM0142), the major ions increased slightly and specific conductance increased to 635 µSie/cm (compared to 380 µSie/cm at the outlet ZM0142) (Figure 29). Coliform remained at maximum levels, and phosphorus and nitrogen increased due to the sewage/wastewater input from the lower tributary. Copper and zinc which were elevated in the upper tributary, were both diluted (Figures 32,33).

4.28 **Virginia River Above Quidi Vidi Lake ZM0014**

Virginia River was sampled 30 metres above Quidi Vidi Lake. This site has been under the Canada-Newfoundland Water Quality Monitoring Agreement since 1986 (Table 19). The geology is of the St. John's-Signal Hill Group and the surficial geology is a vegetated rocky till; although, most areas are now developed.

The major ions increased causing specific conductance to jump from 635 to 812 µSie/cm. Calcium, magnesium, sodium and chloride all increased in concentration whereas sulphate decreased. The ratio of sodium to chloride indicated sea spray. The increase in calcium was reflected in a greater concentration of alkalinity, and pH remained at 6.9 pH units. Heavy metals were all below detection limit, which indicates a flocculation above this site.

The long term data collected at this site provides the temporal characteristics of Virginia River. Each year between November and April, specific conductance ranges between 1000 to 3000 µSie/cm (Figure 40). Large inputs of sodium and chloride from winter road salting operations is gradually increasing the yearly leachate of these ions. Increased concentrations of calcium, potassium and magnesium are supplied by ground water which influences the alkalinity of the system. During precipitation, the pH and alkalinity decrease, but after the runoff, the ground water input increases both the alkalinity and pH levels (Figure 41). The increase of nitrate/nitrite and phosphorus during early winter may be runoff from local lawns.

Copper and zinc exceeded guidelines only during the winter months. These fluctuations suggest a movement of complexed metals during high discharge. With the

use of unleaded gases, lead concentrations have decreased over the four year period with only a sporadic event rising above the detection limit. A similar pattern is observed with mercury (Figure 43).

The analysis of organic compounds indicates that alpha and gamma-BHC were slightly above their detection limit. The analytical contaminant, 1,4-dichlorobenzene was present at 11.9 ng/L (Section 6.3), and total PCB's decreased to less than the 9 ng/L detection limit.

A forage fish sample (ZM0149) was analysed for organic compounds and metals (Table 17). The organic analysis show elevated levels of total PCB's (1950 ng/g). This concentration is ten times that found in the Waterford Survey and higher than the Rennies River's sample. The concentration in the forage fish indicate the bioavailability and bioaccumulation of PCB's. Mercury concentrations are one tenth the 0.5 mg/kg guideline (IJC, 1976), and copper and lead are similar to concentrations found above Long Pond on Leary's River. Zinc's concentration of 49.7 mg/kg is similar to that on Rennies River above Quidi Vidi Lake, but above the 39.9 mg/kg concentration found above Long Pond.

4.29 **Quidi Vidi Lake ZM0015**

Virginia River flows into the north side of Quidi Vidi lake and Leary's Brook-Rennie's River flows in its western end (Map 7). The lake is approximately 1.5 kilometres long and 500 metres wide. The outlet is located at the east end, and flows 200 metres into Quidi Vidi Harbour. The collection site (ZM0015) is located at the lake's outlet. Both tributaries cross similar geological bedrock and till and the specific conductance at the River's outlets are similar; (approximately 800 μSie/cm). After the tributaries mix in Quidi Vidi Lake, the specific conductance drops to 533 μSie/cm (Figure 29), and pH remains at 6.8 pH units (Figure 30). The geological metals from Rennies River are diluted to concentrations slightly higher than those of Virginia River (Figure 31), and the heavy metals concentrations are diluted below the guidelines or to the detection limit as is the case with mercury (Figures 32,33). Faecal coliform drops from the maximum count in both Rivers to 130 coliforms/100 mL at the outlet. This concentration is above the 10/100 mL raw drinking water guideline, but below the recreational guideline (CCREM, 1987).

Quidi Vidi Lake Outlet is a long-term monitoring site under the Canada-Newfoundland Water Quality Monitoring Agreement (Table 20).

Figure 44 displays the temporal specific conductance of Rennies River, Virginia River and the Lakes outlet over a four year period.

The specific conductance at the outlet ranged between 300 to 1300 μSie/cm, which is 3 times lower than the conductance at the tributaries. The major ions influencing the specific conductance were sodium and chloride (Figures 45). The ratios of these indicate

a sea spray source. This is expected since the site is 750 metres from the Atlantic Ocean. The sharp peaks in major ions and specific conductance usually occurs during winter storms when large amounts of road salt is used. Leary's Brook/ Rennies River contributes a greater input of NaCl ions than Virginia River (Figure 44). The annual spring thaw decreased pH concentrations to 6.6 pH units (Figure 46). The elevated sulphate content during these acidic periods suggest the presence of H_2SO_4 from the prior winter snowfalls. Summer pH can reach 7.7 units.

Aluminum, manganese, iron and silica concentrations increase during December to April, a time of ice cover and greater ground water influence. The latter two elements have increased over the later year which may indicate new bedrock exposure. Lead, copper and mercury concentrations which are complexed with sediment are resuspended in the water column during high discharge. In latter years, the concentration peaks are decreasing as contaminated sediment is diminished. During the peak discharge periods, all three sites produced similar peaks which indicates that sediment is flushed from the freshwater and carried to the Harbour. During mid-range discharge periods, when sediment is still being flushed from the Rivers, it appears to settle in Quidi Vidi Lake, and this causes peaks at the river sites to be higher than at the Lake outlet.

Lead concentrations (Figure 47) have decreased since 1986. In recent years, peaks occur only during the flushing of a high discharge. This decrease is probably related to the restricted use of leaded fuels. Copper concentrations have also decreased since 1989. These peaks usually fall within two times the 0.002 mg/L guideline (Figure 50). Mercury also continued to decrease, and the drop in concentration from 0.02 μg/L to 0.01 μg/L in late 1987 is a result of a lower analytical detection limit. The peaks during flushing periods do not exceed the 0.1 μg/L guideline for protection of aquatic life (CCREM, 1987) (Figure 48). The more heavily developed Rennies River contained higher concentrations than Virginia River during the earlier years of sampling. The concentrations of zinc have remained stable over the four year period. Only during high discharge does the zinc concentrations at each site exceed the .03 mg/L guideline (Figure 49). In recent years, galvanized products have been increasingly used in construction and because of its popularity, zinc concentrations are expected to remain stable.

The organic compounds analysis of surface water at Quidi Vidi Lake outlet found the ubiquitous alpha and gamma-BHC compounds at trace concentrations, and the analytical contaminant 1,4-dichlorobenzene. Because no other organic compounds were detected at the outlet, those compounds present in the tributaries are remaining in the Rivers or Lake and are transported to the Harbour only upon high discharge.

4.30 **Summation of the Quidi Vidi Lake Basin**

Quidi Vidi Lake is located north of St. John's Harbour and flows into Quidi Vidi Harbour. Leary's Brook-Rennies River and Virginia River are the Lakes tributaries. The headwater of each tributary is located just east of the undeveloped area about Windsor Lake.

The headwater sites were sampled four months prior to the survey. In the winter-spring seasons, the pH is more acidic than the summer pH of 6.7 units (Figure 23). Nutrients, coliform and heavy metal data indicate the absence of sewage/storm outfalls, and the ratio of sodium to chloride indicates a road salt leachate. Downstream from the Leary's River headwaters (ZM0042) is the pristine Carty's Stream tributary (ZM0128). A sediment sample (ZM0136) collected below Juniper Ponds and Carty's Stream found all varibles below "lowest effect level" guideline (Persaud, et al., 1992). A surface water sample above Thorburn Road (ZM0127) indicates elevated levels of nutrients and coliform.

Oxen Pond tributary joins Leary's Brook at Wigmore Pond. A surface water sample from the tributary above Oxen Pond Road (ZM0129) found elevated phosphorus which would suggest an input of wastewater.

A sample from Leary's Brook below Wigmore Pond (ZM0125) found the total coliform count and nitrate concentrations to suggest a surface runoff (Figure 28).

Leary Brook joins with Yellow Marsh stream below Wigmore Pond. This tributary originates from two branches. The north branch (ZM0046) indicates no impact. The South Branch (ZM0123) has faecal coliform counts of 5000/100 mL which exceeds the 2000 count guideline for recreation use, elevated copper and zinc concentrations and an elevated sodium and chloride content from road salt leachate. No organic compounds were detected in the surface water. These two branches join to form the main Yellow Marsh stream. The resultant water quality at site ZM0126 is a dilution of the southern Branch variables by the northern Branch. The largest decreases were observed with faecal coliform (1200/100 mL) and the associated nutrients (Figure 28).

Site ZM0124 on Leary's Brook was located below an outfall pipe. The faecal coliform count was 3400/100 mL sample which indicates the input of sewage (Figure 28). Organic compounds in the surface water were below the detection limits.

Below this site, Leary's Brook flows underground. Sample ZM0130 was collected at the resurfacing point adjacent to Prince Phillip Drive. A decrease in faecal coliform and increase in total coliform indicates the absence of additional sewage input. An organic compound analysis of the surface water detected methylnaphthalene at twice its 10 ng/L detection limit and PCB's at 12.3 ng/L.

Above Long Pond, a surface water sample (ZM0138) found a decreasing coliform count of 800, and an elevated nitrate source which is likely from run-off (Figure 28). A water analysis for organic compounds indicated a PCB concentration at 19 ng/L. A forage fish sample contained elevated copper, lead and zinc concentrations.

Nagles Brook tributary enters the north side of Long Pond. The headwaters are pristine (ZM0070), and the lower site contained elevated nitrate from runoff and a NaCl road salt leachate.

A sediment sample was collected in Long Pond adjacent to the outflow of each tributary. Each site contained numerous elevated compounds, but site ZM0134 opposite Leary's Brook contained numerous PAH compounds. PCB concentrations were the highest of both surveys measuring 30,000 to 52,000 ng/g. Site ZM0139 opposite Nagles Brook, contained similar compounds, but at lower concentrations. Both sites contained elevated concentration of copper, zinc and lead (Figure 35) which exceed the guidelines expected to be detrimental to aquatic communities (Persaud, et al., 1992).

Sample ZM0133 was collected at the outlet of Long Pond in Rennies River. Generally, the Pond is a sink for variable from Leary's Brook. Faecal coliform decreased from 800 to 10/100 sample. Total coliform dropped from 5000 to 80 (Figure 28). An organic compound analysis of the surface water found PCB's at 20.1 ng/L.

Below the outlet, Kent's Pond tributary enters Rennies River. A sediment sample (ZM0135) from Kents Pond contained numerous PAH compounds and a low concentration of PCP. Metal analysis found copper, nickel, lead and zinc at elevated concentrations (Figure 35). A surface water sample above the confluence with the River indicated the absence of sewage input (ZM0132).

Further down Rennies River, Kelly's Brook tributary (ZM0144) drains an old section of St. John's. The inadequate sewage system in this area is reflected in the maximum count of coliform and elevated nutrients (Figure 28).

Site ZM0016 above Quidi Vidi Lake has been sampled monthly since 1986 under the Federal/Provincial Water Quality Agreement. The water characteristics of the River fluctuate with the discharge. The NaCl-specific conductance increase shows the degree of NaCl soil saturation and the quantity of seasonal runoff (Figure 36). Heavy metals increase during high discharge which suggest a movement of sediment from contaminated sites upstream (Figures 39). A surface water analysis of organic compounds detected low concentration of PCBs and 1,2,4-trichlorobenzene. A forage fish sample contained low levels of PCB, and elevated lead, copper and zinc (Figure 34).

North of Quidi Vidi Lake is Virginia River. This tributary originates in the semi-developed headwaters east of Windsor Lake (ZM0098). Coliform counts are low and the NaCl ratio indicates a road salt source. Sample ZM0143 was collected above

Torbay Road. The water quality at this site is similar to the headwaters, except sea spray is more prominent than road salt as a source of NaCl.

Site ZM0141 is located between Torbay Road and Virginia Lake. Coliform at maximum counts, and elevated nutrients and heavy metals indicate sewage input (Figures 28,32,33).

A sediment sample (ZM0140) from Virginia Lake adjacent the River's inlet detected numerous PAH compounds. Analysis found copper, zinc and mercury at 25 percent those concentrations found in Long Pond (Figure 35). Sample ZM0142 collected at the Lake's outlet contains surface water variables at lower concentrations than found above the inlet. Faecal coliform levels dropped from 26,000 to 180/100 mL, and heavy metals fell to below detection limit. An organic compound analysis of the surface water contained PCB's at 11 ng/L.

Below the Lake, two tributaries enter Virginia River (ZM0146, ZM0147). Each of the tributaries receives sewage, and coliform and nutrients levels are elevated (Figure 28). The lower tributary, above a golf course, also contains elevated copper and zinc.

Sample ZM0014 was collected above Quidi Vidi Lake. Coliform levels are at maximum counts, nutrients are elevated, but the heavy metal are less than detection limit. This site is collected monthly under the Federal-Provincial Water Quality Monitoring Agreement. During winter storms and spring discharges, the specific conductance can rise to 3000 μSie/cm, but usually peaks at 1000 μSie/cm (Figure 40). At these times, the zinc and copper concentrations also become elevated (Figure 43). No organic compounds were detected in the surface water. A forage fish sample contained 1950 ng/g of PCB, and metal concentrations were similar to those found in fish from Long Pond.

A sample from the outlet of Quidi Vidi Lake (ZM0015) found below detection limit concentrations of organics and metals. The concentration of coliform also decreased from the maximum counts to 130/100 mL sample.

Long term patterns show a gradual increase of specific conductance due to road salt (Figures 44,45), and heavy metals usually remain below detection limit with sporadic increases during high discharge periods (Figures 47,50).

5.0 Comparisons of the Waterford River Basin and the Quidi Vidi Lake Basin

The two watersheds within the City of St. John's are located close enough to each other that the headwaters of the Waterford River's Mundy Pond is separated from Yellow Marsh Stream of the Quidi Vidi System by only 1.5 kilometres. Each watershed has similar surficial geology, annual precipitation catchment areas, and seasonal discharge. The Waterford River has a catchment area of 65 square kilometres, originating in the large organic deposits south of the River. Quidi Vidi catchment area is 75 square kilometres originating west of Windsor Lake. This area contains smaller organic deposits than does the southern waterford Basin.

Each basin has a daily mean discharge of approximately 6 to 10 cms (Figures 4,6). The higher peaks recorded on the Waterford River are a result of the total discharge passing through one River, whereas the Quidi Vidi basin's discharge is divided between two rivers. From the headwaters to each Harbour, both basins flow through a similar degree and type of urban development. The headwaters are generally undeveloped, impacted only by hydropower corridors and secondary roads. As the rivers flow towards the Harbours, they pass through the outer suburban portions of the City. The lower reaches of each River passes through the older urban sections.

The Waterford River has experienced a greater degree of impact in the headwaters than the Quidi Vidi Basin. Major highways follow the Waterford River before turning south along the Avalon Peninsula and this area is an intersection for electrical power corridors. The Quidi Vidi headwaters are outside the core of development.

As each river flows toward the City, they pass through residential areas. The input of sewage and urban runoff occurs throughout both Basins, although two residential areas have a modern infrastructure which carries effluent away from the immediate area. In the Waterford River Basin, sewage inputs occur at the trailer park (ZM0078) located at the confluence of Brazil Pond tributary and Bremigan's Tributary and from the Elizabeth Park Trailer Park (ZM0080). Both contribute high counts of coliform and elevated heavy metals into the River. Similar sewage inputs occur throughout the River and maintain coliform counts above recreational guidelines. The elevated heavy metal concentrations associated with the outfalls usually decrease to below guidelines through flocculation. In the Quidi Vidi Basin, both Leary's Brook and Virginia River contain elevated coliform counts just below headwater sections (ZM0127, ZM0141). Elevated heavy metals input occur at Yellow Marsh Stream (ZM0123) and at the two tributaries below Virginia Lake (ZM0147, ZM0148). The quick flocculation of the metals reduces their detection. The inflow of sewage and wastewater becomes more concentrated in the lower sections of each River. These areas are older and lack modern separated sewer system. Such areas are: Waterford River at South Brook (ZM0090), Mundy Pond outlet (ZM0094), and Rennies River at Kelly's Brook (ZM0148).

Another impact is urban runoff. Urban contaminants like oils, grease, metals, PAHs and road salt get flushed into the Rivers during storms and snow clearing operations. Brazil Pond (ZM0100), Waterford River contained elevated concentrations of grease, oil and PCB's. In Leary's Brook above Long Pond (ZM0134), elevated concentrations of PCB's were found in sediment and in the surface water. The source of this compound is likely an electrical transformer leak. Road salt in runoff and leachate is also affecting both basins. Figures 13 and 44 display the increase in specific conductance, sodium and chloride ions. Figure 1 shows the quantities of road salt which have been applied to the Cities' roads. The peaks caused by direct runoff are of short durations and cause minor impacts since these ions are flushed out of the system. The detrimental impact is the saturation of the soil adjacent to the roads which is supplying a continuous leachate of sodium and chloride to both Rivers. As the City expands, so will the peaks and yearly leachates of sodium and chloride.

Mundy Pond (ZM0102) in the Waterford River Basin is contaminated with organics and metals because of a former asphalt plant which operated on the Pond's perimeter, and backfill from construction and demolition sites. Over the years, these contaminants have become bound to sediment and are not found in the surface water. Although the bioaccumulation factor is high for these compounds, the bioavailability should be low. In Quidi Vidi basin, elevated PAHs and heavy metals were present in sediment of Long Pond (ZM0134), Kent's Pond (ZM0135) and Virginia Lake (ZM0140). Because the concentrations are highest in Long Pond, and least in Virginia Lake, a point source appears to be present. Potential large present sources include a boiler and garbage incinerator in the area of Long Pond. Other sources of PAHs would be automobiles, heating systems, and urban runoff.

The impact from the Rivers upon the Harbour environments is seasonal. On the Waterford River, a small pond exists at Kilbride which traps a percentage of contaminated sediment and reduces the amount of contaminant entering the Harbour. The same action occurs on Leary's Brook at Long Pond, Virginia River in Virginia Lake and in Quidi Vidi Lake.

Because of the seasonal effect, concentrations of compounds above guidelines occur during high discharge periods.

Both these basins contain similar aquatic environments, as a result of similar histories, physical aspects and anthropogenic inputs. Although certain areas have been contaminated, the natural processes of deposition and flushings continues to provide an environment which can support an acceptable and often vibrant aquatic community. However recreational contact uses of the watersheds is compromised in several areas. In general, drainage flows to the Harbour where sediment accumulates due to the generally less energetic hydrodynamics. Elevated PAH and metal concentrations were observed in the one Harbour sample collect in this survey.

6.0 QUALITY CONTROL/QUALITY ASSURANCE

To establish a degree of credibility when producing concentration data, a project must include verifiable quality control/quality assurance procedures (QA/QC) for the field collection and laboratory analytical practices. As part of the Waterford River and Quidi Vidi System Recurrent Surveys, the following QC procedures were implemented; triplicate, blank, organic spiked samples for surface water, and triplicate samples for sediment. All three procedures can indicate contamination, and/or the reliability of sampling and analytical methods. The field quality control augments the laboratory practices of QA/QC which are routine in the National Water Quality Laboratory and at the Monitoring and Evaluation Laboratory in Moncton.

6.1 Triplicate Samples - Surface Water - Sediment

Sequential triplicate samples are three sets of samples from one location collected in sequence. The resulting data from this quality control procedure should indicate sampling representativeness, sample contamination, and/or data management problems. A general guideline used by Roussel et al. (1991a), suggest that triplicate sample results should not vary by more than 10 percent. Tables 21 and 22 lists the triplicate surface water sample results and Tables 6, 7, 15, and 16 list the triplicate sediment results from the Waterford River and Quidi Vidi surveys. The triplicate samples from this report's surveys were collected by the same sampler, and transportation occurred at the same time for each survey, plus bottles were cleaned and analysed at one laboratory.

The data indicates that the triplicate samples are representative of the sites in both Surveys. In sample ZM0133 of the Quidi Vidi Survey, iron, total nitrogen and dissolved organic carbon in one of the triplicate is 1.5 times greater than the latter two. These values are still acceptable because a surge of DOC could increase organic nitrogen and iron. The triplicate sample, ZM0147, of the Quidi Vidi Survey also shows a similar phenomenon, but with no increase in iron. Sediment triplicate samples are acceptable with a few outliers.

6.2 Blank Samples - Surface Water - Routine Analysis

Preservation blanks were prepared in both surveys. These consist of sample bottles filled with distilled water and transported to and from the field. Upon delivery to the laboratory, a phosphorus sub-sample is removed, and the remaining sample is preserved for metal analysis. These Q.C. samples should verify if bottles have been contaminated, and also the cleanliness of bottles and preservative (Roussel, et al., 1991a). Tables 23 and 24 list the blank sample results from the Waterford and Quidi Vidi Surveys. The data indicates that both surveys used uncontaminated sample bottles and no external contamination occurred; therefore, the data can be considered reliable. The detection limit concentrations of phosphorus and iron are attributed to analytical variability.

6.3 Spikes, Blanks - Surface Water - Organic Analysis

During each survey, two sites were chosen for quality control organic analysis. At each site, blank samples, spiked samples, and natural samples were collected; Tables 26, 27. The blank samples consist of distilled laboratory water. These determine if a group of samples were contaminated, and if so, the concentration of the organic compound. The spiked blank is distilled water which has been "spiked" by adding to it 100 μL of prepared spiking solution. Results will represent the final quantity to be expected from a clean matrix. By using the calculation in Appendix 1, the percent recoveries of each organic compound contained in the spike can be calculated (Gaskin, 1988). The same procedure is also used with field samples. Water samples are collected and one is spiked with the same solution as used with the blanks, the other remains unspiked. By subtracting the recoveries of spiked field sample from natural field sample and dividing by a known concentration, percent recoveries for organic compounds in a natural matrix can be calculated. The percent recoveries will provide an indication of the degree of confidence which can be placed upon the organic quantities in natural field samples.

A percent recovery of less than 100 indicates that the compound is estimated low, and if the recovery is above 100%, the value suggests that the quantity is over estimated. According to Léger (1990), 100% recoveries indicate excellent performance, and values outside the 40 to 155% range should be considered abnormal for trace analyses and not used in calculations.

Tables 26 and 27 list the results of the organic analysis. In the "blank" samples, 1,4 dichlorobenzene was present. 1,4-Dichlorobenzene is a common volatile compound and many laboratories detect this contaminant in samples. 1,2,4-Trichlorobenzene, another volatile substance, was detected in one blank of the Quidi Vidi survey. This recovery also indicates contamination.

Tables 28 and 29 list the percent recoveries of compound in spiked and unspiked samples.

Each compound in the spiking solution should be present at a minimum concentration which is 10 times the detection limit of the analysing instrument (Léger 1990). If this condition is not met, the recoveries are usually "less than detection limit". This report will use the notation "NA", or not applicable, when the concentration of the spike is less than the instrument's detection limit (Tables 27, 28).

The above problem occurred in both surveys, although more so in the Waterford, Table 27. The Quidi Vidi survey reduced the number of problematic PAH compounds present in the spiking solution, hence improved the number of compound recoveries.

The Quidi Vidi percent recoveries are also more consistent than those of the Waterford Survey. Through discussion with field personnel, the Waterford samples appear to have been given the 100 µL of spiking solution in 2 applications (50 µL each). This method can be confusing which results in some samples being given only half the spike. Spike #1 of the Waterford Survey shows its concentrations as 50 percent of that of Spike 2 and the blank; therefore we can assume these percentages should be doubled.

In both surveys, most PAH's were present in unquantifiable concentrations, hence listed as "NA". A PAH data review found that these compounds are less stable than chlorinated compounds, and in the past have been problematic in analysis and should be viewed with caution (Léger, 1990). The chlorinated phenol compounds were present in the Waterford Spiking Solution, but because of low concentration, were reported as "NA".

Both surveys used chlorinated benzenes in the spiking solution. The data reveals the volatile nature of the less substituted benzenes; hence, lower recoveries.

The final group of compounds were the organochlorines. Of the two surveys, the organochlorines produced the most consistent results with the Quidi Vidi Survey, producing a tighter range of vaues and higher recovery rate.

The organochlorines and chlorinated benzenes can be considered reliable, although underestimated. The polynuclear aromatic hydrocarbons (PAH's) and chlorinated phenols were not of sufficient quantity and so many compounds could not be evaluated.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The 1989-1990 Recurrent Surveys of the Waterford River Basin and the Quidi Vidi Lake Basin assessed the aquatic environment to determine the degree of anthropogenic impact and to follow up on the 1980-1984 Waterford River Study (Arseneault et al. 1985). The samples represented the aquatic matrices of surface water, sediment and forage fish.

The surface water of both Basins have received some form of anthropogenic impact. In headwater sites, inputs from hydropole leachate to urban runoff was detected. The mid sections contain elevated coliforms, major ions, heavy metals, and organic compounds in the water column and sediment.

In remote areas, low concentrations of organic compounds from atmospheric deposition were detected. In developed areas, numerous compounds were present as a result of immediate sources. At Mundy Pond (Waterford River), the principle source was a former asphalt plant. The concentrations here should remain stable and become less bioavailable as new sediment is deposited. In Long Pond (Quidi Vidi System), the sources of organic compounds, and metals apppear to be urban runoff, and industrial emissions. In both systems, the heavy metals and organic compounds are resuspended in the water column during the flushing of high discharge periods. During a maximum discharge, the sediment is flushed into the Harbour. During lower discharges, the sediment is deposited in ponds and sheltered areas of the Rivers.

An increasing impact is the annual leaching of sodium and chloride ions. The winter application of road salt has saturated the soil of the River banks and is causing the normal baseline concentration of Na-Cl ions to increase. The results is seen in an annual increase in ions' concentrations and in specfic conductance in both basins. The impact of the increasing ions concentrations upon the present benthic communities may be extensive, if the communities can not adapt.

The most apparent impact upon these basins, as was seen in the 1985 study, is from untreated sewage and wastewater. The developed areas of both basins contain water quality variables which exceed the Water Quality Recreational Guidelines throughout the year, and exceed the Guidelines for the Protection of Freshwater Aquatic Life during high discharge periods. A major step to cleaning up these watersheds is the use of wastewater treatment. Although treatment will significantly improve the freshwater systems it is only part of the solution for the harbour's environmental quality. The harbours also receive material directly from shipping activity, and from material that is flushed directly from sewers, and storm events. These sources account partly for the varied concentrations found in the sediment, and should be primary concern in a plan to improve the quality of the this system.

The 1989 survey of the Waterford River has addressed most of the recommendations put forth in the 1985 report. Temporal data from Agreement stations

and a pressuring data set of water quality variables, which included ten percent quality control samples were interpreted to determine the present state and changes in the aquatic ecosystem.

Future studies should investigate the following:

1) Quantify the future concentration of trace organics and heavy metals in Long Pond, Kents Pond and Virginia Lake.

2) Determine the degree of bioaccumulation and bioconcentration of trace organics and heavy metals in the aquatic ecosystem of both Basins (e.g. Kents Pond).

3) The long term data indicates an above guideline concentration of heavy metals during high discharge periods. Analysis of dissolved heavy metals during high and low discharge is warranted to determine the concentration of variables becoming redissolved and bioavailable and to determine the loadings to the Harbour.

4) A survey of sediment in the St. John's Harbour and Quidi Vidi Lake and Harbour to better describe the magnitude of contamination in these pre-marine and marine water bodies.

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9.0 APPENDIX I

SPIKE RECOVERY:

To determine the degree of confidence that can be placed on analytical results, the effects and performance of the samples, spikes and instruments need to be known. To determine these variables, spike recovery:percentage needs to be calculated using the formula in Gaskin (2):

$$\% \text{ recovery} = \frac{(C_F - C_B^{\cdot})}{C_A} \times 100$$

C_F	=	measure concentration in the spiked sample (field or blank)
$C_B^{\cdot}$	=	average concentration in sample (field or blank)
C_A	=	known concentration of spike added to sample (field or blank)

This equation works on the principle that if the matrix effects are removed from the equation and the volume and concentration of the spiking solution added is known, the percent recovery of spiking solution can be calculated, eg:

$$\% \text{ recovery for field spike} = \frac{\text{field spike value - field value}}{\text{spike}} \times 100$$

This recovery provides the interpreter with a degree of confidence as to the level of a compound reported in an ambient field sample.

TABLE 1

LIST OF STATIONS SAMPLED DURING THE 1989 WATERFORD RIVER BASIN RECURRENT SURVEY

STATION #		DESCRIPTION
1.	00NF02ZM0076	Lat. 47°30'53" Long. 52°51'52" Unnamed tributary of Waterford River, 100m upstream above Bremigan's Pond, midstream.
2.	51NF02ZM0100	Lat. 47°31'22" Long. 52°51'06" Unnamed pond on Waterford River, 0.5km down-stream of Bremigan's Pond dam, right bank.
3.	00NF02ZM0072	Lat. 47°31'26" Long. 52°51'02" Waterford River, approx. 0.75 km downstream of Bremigan's Pond dam, midstream.
4.	00NF02ZM0078	Lat. 47°31'47" Long. 52°50'14" Waterford River, Bremigan's Pond branch, 100m upstream of confluence with Brazil Pond branch
5.	51NF02ZM0101	Lat. 47°32'02" Long. 52°51'02" Brazil Pond at the northern tip of the pond 2m from bank, access from Topsail Road
6.	00NF02ZM0077	Lat. 47°31'57" Long. 52°50'47" Unnamed tributary of Waterford River, 200m downstream of Brazil Pond.
7.	00NF02ZM0079	Lat. 47°31'52" Long. 52°50'18" Brazil Pond branch of Waterford Riverat confluence with Bremigan's Pond branch, at outlet of culvert.
8.	00NF02ZM0080	Lat. 47°31'55" Long. 52°50'22" Northwest tributary of Waterford River at Elizabeth Park, 50m upstream of confluence with main stem.
9.	00NF02ZM0081	Lat. 47°31'50" Long. 52°50'25" Waterford River at Trans Canada Highway.

STATION #		DESCRIPTION
10.	00NF02ZM0073	Lat. 47°30'32" Long. 52°51'09" Unnamed tributary of Waterford River, approx. 100m upstream of Harbour Arterial Road.
11.	00NF02ZM0082	Lat. 47°31'45" Long. 52°50'04" Unnamed tributary of Waterford River, western branch of Donovan's Industrial Park, 25m upstream of confluence with Waterford River.
12.	90NF02ZM0082	Lat. 47°31'45" Long. 52°50'04" Unnamed tributary of Waterford River, western branch of Donovan's Industrial Park, 25m upstream of confluence with main stem.
13.	00NF02ZM0003	Lat. 47°31'45" Long. 52°49'49" Waterford River at bridge on private road at Donovan's 0.5km east of TCH
14.	90NF02ZM0003	Lat. 47°31'45" Long 52°49'49" Waterford River at bridge on private road at Donovan's 0.5km east of TCH.
15.	00NF02ZM0083	Lat. 47°31'21" Long. 52°49'27" Unnamed tributary of Waterford River, east of Donovan's Industrial Park, at confluence of two adjoining streams.
16.	00NF02ZM0004	Lat. 47°31'19" Long. 52°48'29" Waterford River at bridge on Commonwealth Ave., St. John's
17.	00NF02ZM0012	Lat. 47°31'15" Long. 52°46'41" Waterford River at bridge on Dunns Road.
18.	00NF02ZM0087	Lat. 47°31'23" Long. 52°46'49" Branscombe's Pond branch, 300m above confluence with Waterford River
19.	00NF02ZM0086	Lat. 47°31'14" Long. 52°46'40" Unnamed tributary south of Mount Pearl, 5m above confluence with Waterford River.

STATION #		DESCRIPTION
20.	00NF02ZM0085	Lat. 47°31'16" Long. 52°46'26" Waterford River, 10m above confluence with Flings Brook.
21.	00NF02ZM0088	Lat. 47°30'14" Long. 52°48'18" Flings Brook, 100m downstream of Old Placentia Road, Mount Pearl.
22.	00NF02ZM0006	Lat. 47°30'50" Long. 52°46'54" Flings Brook at intersection with entrance road adjacent to Agriculture Canada Station, St. John's.
23.	00NF02ZM0084	Lat. 47°31'10" Long. 52°46'26" Flings Brook, 100m upstream of confluence with Waterford River.
24.	51NF02ZM0084	Lat. 47°31'10" Long. 52°46'26" Flings Brook, 100m upstream of confluence with Waterford River
25.	00NF02ZM0075	Lat. 47°32'23" Long. 52°46'14" Kitty Gauls Brook approx. 30m upstream of Blackmarsh Road culvert.
26.	00NF02ZM0089	Lat. 47°31'40" Long. 52°44'57" Waterford River 300m above confluence with South Brook, Bowring Park.
27.	90NF02ZM0089	Lat. 47°31'40" Long. 52°44'57" Waterford River 300m upstream confluence with South Brook, Bowring Park.
28.	00NF02ZM0001	Lat. 47°29'43" Long. 52°48'36" South Brook at culvert on Ruby Line Rd.
29.	00NF02ZM0007	Lat. 47°29'52" Long. 52°47'26" South Brook at intersection with Heavey Tree Road.

STATION #		DESCRIPTION
30.	00NF02ZM0008	Lat. 47°30'38" Long. 52°45'50" Tributary of south Brook draining Dead Mans Pond at intersection 200m south of Arterial Highway at old Bay Bulls Road.
31.	00NF02ZM0096	Lat. 47°31'10" Long. 52°46'54" Petty Harbour-Long Pond tributary at Old Petty Harbour Road.
32.	00NF02ZM0090	Lat. 47°31'34" Long. 52°44'56" South Brook 300m upstream of confluence with Waterford River, Bowring Park.
33.	50NF02ZM0009	Lat. 47°31'45" Long. 52°44'34" Waterford River at Kilbride at gauge.
34.	00NF02ZM0091	Lat. 47°32'10" Long. 52°44'07" Waterford River 200m downstream of Waterford Lane Bridge.
35.	51NF02ZM0103	Lat. 47°32'10" Long 52°42'55" Beaver Pond at the northeastern tip of the pond, midway between the two banks
36.	00NF02ZM0095	Lat. 47°32'11" Long. 52°43'34" Beaver Pond tributary of Waterford River at old dirt road just south of St. John's Harbour Arterial Road (10m upstream of dirt road).
37.	00NF02ZM0092	Lat. 47°32'40" Long. 52°43'15" Waterford River at Syme's Bridge.
38.	29NF02ZM0097	Lat. 47°32'54" Long. 52°43'14" Waterford River approx. 100m upstream of South Side Road overpass, at mouth of waste outfall pipe on left bank.
39.	00NF02ZM0074	Lat. 47°32'44" Long. 52°45'37" Unnamed tributary of Waterford River approx. 10m downstream of outlet of unnamed pond at Empire Ave.

STATION #		DESCRIPTION
40.	51NF02ZM0102	Lat. 47°33'08" Long. 52°44'27" Mundy Pond, halfway between right shore of pond and small island.
41.	90NF02ZM0109	Lat. 47°33'06" Long. 52°44'39" Mundy Pond, at right shore 10m above pond outlet.
42.	00NF02ZM0094	Lat. 47°33'23" Long. 52°42'58" Mundy Pond tributary at confluence with Waterford River, at mouth of outfall pipe on left bank.
43.	00NF02ZM0093	Lat. 47°33'09" Long. 52°42'53" Waterford River, approx. 500m upstream of St. John's Harbour, 1m from left bank.
44.	53NF02ZM0104	Lat. 47°33'18" Long. 52°42'40" St. John's Harbour 100m below Pitts Memorial Drive, from the right side dock.

TABLE 2
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES
MAJOR IONS, METALS AND NUTRIENTS

STATION	SAMPLE DATE	SAMPLE TIME	SP COND FIELD USIE/CM	PH FIELD PH UNITS	DISS OXYGEN MG/L	TEMP FIELD DEG.C.	PH LAB PH UNITS	SP COND LAB USIE/CM	TURB JTU	TOTAL ALKALIN MG/L
1 BREMIGANS POND										
2 00NF02ZM0076	08-AUG-89	1030	580.0	4.7	3.8	18.7	4.8	553	6.9	-0.6
3 00NF02ZM0072	08-AUG-89	1130	184.0	6.1	7.2	20.4	6.1	178	0.9	3.5
4 00NF02ZM0078	09-AUG-89	1000	920.0	6.3	6.7	19.6	6.3	907	0.7	5.1
5 00NF02ZM0078	09-AUG-89	1005	920.0	6.3	6.7	19.6	6.3	905	0.6	5.0
6 00NF02ZM0078	09-AUG-89	1010	920.0	6.3	6.7	19.6	6.4	907	0.6	5.2
7 BRAZIL POND										
8 00NF02ZM0077	08-AUG-89	1700	134.0	6.5	6.8	20.9	6.4	129	0.5	4.6
9 00NF02ZM0079	09-AUG-89	1020	330.0	7.0	8.3	14.7	7.0	312	1.8	24.2
10 TRIBUTARY ELIZABETH PARK										
11 00NF02ZM0080	09-AUG-89	1110	360.0	6.8	8.3	19.3	6.7	351	21.0	17.0
12 WATERFORD RIVER										
13 00NF02ZM0081	09-AUG-89	1140	640.0	6.6	6.3	18.7	6.6	632	1.5	14.8
14 TRIBUTARY DONAVANS PARK										
15 00NF02ZM0073	09-AUG-89	1350	144.0	5.2	6.8	19.4	5.4	136	2.1	1.5
16 00NF02ZM0082	09-AUG-89	1430	770.5	6.4	8.2	20.2	6.1	751	0.7	2.3
17 WATERFORD RIVER										
18 00NF02ZM0003	10-AUG-89	1040	760.0	6.5	7.2	16.3	6.5	745	1.7	11.2
19 TRIBUTARY GLENDALE										
20 00NF02ZM0083	09-AUG-89	1630	360.0	6.9	8.5	21.1	6.4	346	1.8	3.5
21 00NF02ZM0083	09-AUG-89	1635	360.0	6.9	8.5	21.1	6.4	345	1.8	3.3
22 00NF02ZM0083	09-AUG-89	1640	360.0	6.9	8.5	21.1	6.5	345	2.1	3.7
23 WATERFORD RIVER										
24 00NF02ZM0004	10-AUG-89	1140	640.0	7.3	9.7	18.3	6.9	624	0.5	7.9
25 TRIBUTARY BRANSCOMBS PON										
26 00NF02ZM0087	10-AUG-89	1700	440.0	7.3	8.9	19.3	7.1	439	0.4	9.5
27 00NF02ZM0087	10-AUG-89	1705	440.0	7.3	8.9	19.3	7.1	440	0.4	9.5
28 00NF02ZM0087	10-AUG-89	1710	440.0	7.3	8.9	19.3	7.1	440	0.4	9.8
29 WATERFORD RIVER										
30 00NF02ZM0012	15-AUG-89	1710	620.0	7.5	8.5	21.1	7.0	620	0.4	9.4
31 TRIBUTARY MOUNT PEARL										
32 00NF02ZM0086	10-AUG-89	1630	500.0	7.5	9.1	18.8	7.2	498	0.4	14.2
33 WATERFORD RIVER										
34 00NF02ZM0085	10-AUG-89	1600	620.0	7.5	9.0	20.5	7.1	599	0.5	9.2
35 TRIBUTARY EXPERIMENTAL F										
36 00NF02ZM0088	10-AUG-89	1830	530.0	7.3	8.7	17.6	7.2	497	7.0	35.7
37 00NF02ZM0006	15-AUG-89	1635	400.0	7.2	7.9	21.2	7.1	403	1.5	23.0
38 00NF02ZM0006	15-AUG-89	1640	400.0	7.2	7.9	21.2	7.0	404	1.5	22.5
39 00NF02ZM0006	15-AUG-89	1645	400.0	7.2	7.9	21.2	7.0	409	1.5	22.6
40 00NF02ZM0084	10-AUG-89	1400	380.0	7.6	8.7	20.1	7.4	379	0.7	20.9
41 TRIBUTARY KITTY G. BROOK										
42 00NF02ZM0075	15-AUG-89	1905	70.0	5.7	6.7	17.5	5.6	63	1.2	1.3
43 WATERFORD RIVER										
44 00NF02ZM0089	14-AUG-89	1125	640.0	7.5	9.7	15.1	7.2	636	0.7	15.5
45 TRIBUTARY SOUTH BROOK										
46 00NF02ZM0001	10-AUG-89	1215	44.0	6.6	8.8	19.9	6.5	43	1.0	4.0
47 00NF02ZM0007	10-AUG-89	1845	134.5	6.8	8.3	20.7	6.7	126	0.8	6.1

TABLE 2
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES
MAJOR IONS, METALS AND NUTRIENTS

STATION	APPARENT COLOUR REL UNITS	DISS CALCIUM MG/L	DISS MAGNES MG/L	DISS POTASS MG/L	DISS SODIUM MG/L	DISS CHLORIDE MG/L	DISS SULPHATE MTB MG/L	DISS SULPHATE MG/L	TOTAL PHOSPH MG/L	EXTRBLE COPPER MG/L
1 BREMIGANS POND										
2 00NF02ZM0076	160	8.2	2.10	1.00	90.0	153.0	8.1	7.1		L.002
3 00NF02ZM0072	25	4.6	1.80	0.47	25.0	49.0	2.8	2.3	0.006	L.002
4 00NF02ZM0078	10	11.0	2.30	2.80	160.0	270.0	10.6	9.7	0.032	0.004
5 00NF02ZM0078	10	13.0	2.30	2.90	163.0	263.9	10.9	9.6	0.032	0.004
6 00NF02ZM0078	10	11.0	2.20	2.80	161.0	264.0	10.7	9.6	0.033	0.004
7 BRAZIL POND										
8 00NF02ZM0077	10	3.0	1.30	0.44	18.7	32.0	2.6	2.2	0.007	L.002
9 00NF02ZM0079	20	18.0	2.20	1.30	38.0	65.0	14.4	13.7	0.014	L.002
10 TRIBUTARY ELIZABETH PARK										
11 00NF02ZM0080		17.0	2.40	1.70	47.0	76.0	18.0	16.9		0.005
12 WATERFORD RIVER										
13 00NF02ZM0081	40	14.0	2.40	2.20	104.0	170.0	12.4	11.2	0.014	0.002
14 TRIBUTARY DONAVANS PARK										
15 00NF02ZM0073	240	3.8	1.80	0.48	17.4	36.0	3.2	1.0	0.025	L.002
16 00NF02ZM0082	5	21.0	4.60	1.80	114.0	211.0	10.5	9.8	0.033	0.002
17 WATERFORD RIVER										
18 00NF02ZM0003	30	18.0	3.40	2.10	119.0	205.0	11.7	10.6	0.013	L.002
19 TRIBUTARY GLENDALE										
20 00NF02ZM0083	10	9.7	2.00	1.00	51.0	98.0	8.1	7.8	0.024	0.003
21 00NF02ZM0083	10	10.0	2.00	1.00	52.0	99.0	8.4	7.7	0.024	0.003
22 00NF02ZM0083	10	10.0	2.10	1.00	51.0	100.0	8.4	7.8	0.024	0.003
23 WATERFORD RIVER										
24 00NF02ZM0004	5	16.0	3.10	1.80	97.0	168.0	11.2	10.4	0.010	L.002
25 TRIBUTARY BRANSCOMBS PON										
26 00NF02ZM0087	5	14.0	3.20	1.20	64.0	120.0	9.6	8.9	0.009	L.002
27 00NF02ZM0087	5	13.4	2.80	1.40	64.0	127.0	9.6	8.9	0.008	L.002
28 00NF02ZM0087	5	13.4	2.80	1.40	64.0	129.0	9.6	9.1	0.009	L.002
29 WATERFORD RIVER										
30 00NF02ZM0012	5	15.3	2.80	2.40	114.0	205.0	11.0	10.4	0.007	L.002
31 TRIBUTARY MOUNT PEARL										
32 00NF02ZM0086	5	18.0	3.90	2.10	69.0	140.0	11.0	9.8	0.015	L.002
33 WATERFORD RIVER										
34 00NF02ZM0085	5	16.0	3.10	1.80	91.0	157.0	10.7	9.8	0.009	L.002
35 TRIBUTARY EXPERIMENTAL F										
36 00NF02ZM0088	200	13.4	2.30	1.40	81.0	131.0	5.9	4.9	0.019	L.002
37 00NF02ZM0006	55	13.7	3.30	3.40	57.0	103.0	6.6	6.2	0.012	L.002
38 00NF02ZM0006	55	13.7	3.30	3.40	57.0	105.0	6.6	6.4	0.012	L.002
39 00NF02ZM0006	55	13.7	3.30	4.00	60.0	104.0	6.5	6.2	0.012	L.002
40 00NF02ZM0084	30	13.0	3.30	3.90	52.0	86.0	7.0	6.2	0.027	L.002
41 TRIBUTARY KITTY G. BROOK										
42 00NF02ZM0075	20	1.7	0.85	0.54	7.7	13.9	3.6	3.3	0.012	L.002
43 WATERFORD RIVER										
44 00NF02ZM0089	10	18.1	3.70	2.20	97.0	167.0	11.6	11.1	0.110	0.003
45 TRIBUTARY SOUTH BROOK										
46 00NF02ZM0001	70	1.6	0.61	0.24	5.2	7.4	2.9	1.4	0.013	L.002
47 00NF02ZM0007	50	4.4	1.30	0.52	17.1	30.0	3.5	2.6	0.010	L.002

TABLE 2
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES
MAJOR IONS, METALS AND NUTRIENTS

STATION	EXTRBLE ZINC MG/L	EXTRBLE CADIUM MG/L	EXTRBLE LEAD MG/L	EXTRBLE ALUMINUM MG/L	EXTRBLE IRON MG/L	EXTRBLE MANGAN MG/L	DISS ORG CARBON MG/L	DISS NITRO NO3,NO2 MG/L	TOTAL NITRO MG/L	SILICA (MB) MG/L
1 BREMIGANS POND										
2 00NF02ZM0076	L.01	L.001	L.002	0.240	6.30	2.70	1.8	0.009	0.09	6.9
3 00NF02ZM0072	L.01	L.001	L.002	0.033	0.75	0.38	2.6	0.009	0.10	4.2
4 00NF02ZM0078	0.01	L.001	L.002	0.030	0.32	0.88	1.9	0.140	0.35	3.7
5 00NF02ZM0078	0.01	L.001	L.002	0.027	0.34	0.87	2.1	0.110	0.28	3.7
6 00NF02ZM0078	0.01	L.001	L.002	0.026	0.32	0.86	2.1	0.130	0.37	3.7
7 BRAZIL POND										
8 00NF02ZM0077	L.01	L.001	L.002	0.022	0.49	0.19	3.7	0.060	0.26	1.3
9 00NF02ZM0079	0.03	L.001	L.002	0.064	0.67	0.49	2.4	0.180	0.29	6.9
10 TRIBUTARY ELIZABETH PARK										
11 00NF02ZM0080	0.22	L.001	0.007		2.20	1.10	5.2	0.180	0.38	7.8
12 WATERFORD RIVER										
13 00NF02ZM0081	0.04	L.001	L.002	0.027	0.83	1.00	2.7	0.120	0.25	5.5
14 TRIBUTARY DONAVANS PARK										
15 00NF02ZM0073	L.01	L.001	L.002	0.270	2.10	0.41	9.5	0.009	0.24	6.7
16 00NF02ZM0082	0.07	L.001	L.002	0.086	0.35	0.83	1.7	0.040	0.09	5.5
17 WATERFORD RIVER										
18 00NF02ZM0003	0.04	L.001	L.002	0.041	1.20	1.10	2.3	0.120	0.24	6.0
19 TRIBUTARY GLENDALE										
20 00NF02ZM0083	0.03	L.001	L.002	0.120	0.35	0.22	2.3	0.120	0.24	2.7
21 00NF02ZM0083	0.03	L.001	L.002	0.120	0.36	0.22	2.4	0.110	0.22	2.7
22 00NF02ZM0083	0.03	L.001	0.002	0.120	0.36	0.22	2.3	0.120	0.26	2.7
23 WATERFORD RIVER										
24 00NF02ZM0004	0.03	L.001	L.002	0.018	0.27	0.37	2.2	0.280	0.42	5.1
25 TRIBUTARY BRANSCOMBS PON										
26 00NF02ZM0087	0.03	L.001	L.002	0.027	0.13	0.17	2.0	0.420	0.57	6.3
27 00NF02ZM0087	0.04	L.001	L.002	0.024	0.13	0.17	2.0	0.410	0.49	6.0
28 00NF02ZM0087	0.03	L.001	L.002	0.020	0.11	0.15	1.9	0.410	0.49	6.1
29 WATERFORD RIVER										
30 00NF02ZM0012	0.01	L.001	L.002	0.013	0.21	0.15	2.0	0.320	0.42	3.8
31 TRIBUTARY MOUNT PEARL										
32 00NF02ZM0086	0.03	L.001	L.002	0.014	0.10	0.04	1.8	1.400	1.40	6.9
33 WATERFORD RIVER										
34 00NF02ZM0085	0.01	L.001	L.002	0.012	0.18	0.11	2.0	0.390	0.48	4.5
35 TRIBUTARY EXPERIMENTAL F										
36 00NF02ZM0088	0.03	L.001	L.002	0.043	2.70	4.80	6.0	0.040	0.22	7.0
37 00NF02ZM0006	0.01	L.001	L.002	0.034	0.93	1.10	5.0	0.130	0.31	5.8
38 00NF02ZM0006	0.01	L.001	L.002	0.028	0.92	1.10	5.0	0.130	0.30	5.8
39 00NF02ZM0006	0.01	L.001	L.002	0.027	0.94	1.10	5.2	0.130	0.32	5.7
40 00NF02ZM0084	L.01	L.001	L.002	0.041	0.33	0.21	5.0	0.360	0.57	4.9
41 TRIBUTARY KITTY G. BROOK										
42 00NF02ZM0075	L.01	L.001	L.002	0.100	0.44	0.51	1.8	0.040	0.10	6.4
43 WATERFORD RIVER										
44 00NF02ZM0089	0.03	L.001	L.002	0.022	0.16	0.13	2.9	0.790	1.20	5.0
45 TRIBUTARY SOUTH BROOK										
46 00NF02ZM0001	L.01	L.001	L.002	0.110	1.30	0.12	5.3	0.009	0.21	5.7
47 00NF02ZM0007	L.01	L.001	L.002	0.062	0.91	0.34	4.4	0.050	0.20	6.1

TABLE 2
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES
MAJOR IONS, METALS AND NUTRIENTS

STATION	EXTRBLE MERCURY UG/L
1 BREMIGANS POND	
2 00NF02ZM0076	L.02
3 00NF02ZM0072	L.02
4 00NF02ZM0078	L.02
5 00NF02ZM0078	L.02
6 00NF02ZM0078	L.02
7 BRAZIL POND	
8 00NF02ZM0077	L.02
9 00NF02ZM0079	L.02
10 TRIBUTARY ELIZABETH PARK	
11 00NF02ZM0080	L.02
12 WATERFORD RIVER	
13 00NF02ZM0081	L.02
14 TRIBUTARY DONAVANS PARK	
15 00NF02ZM0073	L.02
16 00NF02ZM0082	L.02
17 WATERFORD RIVER	
18 00NF02ZM0003	L.02
19 TRIBUTARY GLENDALE	
20 00NF02ZM0083	L.02
21 00NF02ZM0083	L.02
22 00NF02ZM0083	L.02
23 WATERFORD RIVER	
24 00NF02ZM0004	L.02
25 TRIBUTARY BRANSCOMBS PON	
26 00NF02ZM0087	L.02
27 00NF02ZM0087	L.02
28 00NF02ZM0087	L.02
29 WATERFORD RIVER	
30 00NF02ZM0012	L.02
31 TRIBUTARY MOUNT PEARL	
32 00NF02ZM0086	L.02
33 WATERFORD RIVER	
34 00NF02ZM0085	L.02
35 TRIBUTARY EXPERIMENTAL F	
36 00NF02ZM0088	L.02
37 00NF02ZM0006	L.02
38 00NF02ZM0006	0.04
39 00NF02ZM0006	L.02
40 00NF02ZM0084	L.02
41 TRIBUTARY KITTY G. BROOK	
42 00NF02ZM0075	L.02
43 WATERFORD RIVER	
44 00NF02ZM0089	L.02
45 TRIBUTARY SOUTH BROOK	
46 00NF02ZM0001	L.02
47 00NF02ZM0007	L.02

TABLE 2
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES
MAJOR IONS, METALS AND NUTRIENTS

STATION	SAMPLE DATE	SAMPLE TIME	SP COND FIELD USIE/CM	PH FIELD PH UNITS	DISS OXYGEN MG/L	TEMP FIELD DEG.C.	PH LAB PH UNITS	SP COND LAB USIE/CM	TURB JTU	TOTAL ALKALIN MG/L
48 00NF02ZM0008	10-AUG-89	1915	360.0	7.1	7.3	20.8	7.0	361	1.0	17.6
49 00NF02ZM0096	15-AUG-89	1530	310.0	7.0	7.6	18.3	6.9	314	3.4	11.5
50 00NF02ZM0090	14-AUG-89	1300	500.0	8.0	10.6	15.5	7.4	408	0.6	13.6
51 WATERFORD RIVER										
52 00NF02ZM0091	14-AUG-89	1445	580.0	7.7	9.5	16.3	7.3	578	0.6	13.7
53 TRIBUTARY BEAVER BROOK										
54 00NF02ZM0095	15-AUG-89	1450	171.0	6.2	8.8	19.7	6.0	163	0.4	8.8
55 WATERFORD RIVER										
56 00NF02ZM0092	14-AUG-89	1615	600.0	7.8	9.8	17.1	7.4	602	0.5	12.7
57 29NF02ZM0097	15-AUG-89	1330	580.0	6.6	7.2	19.9	6.6	315	6.2	27.1
58 TRIBUTARY MUNDY POND										
59 00NF02ZM0074	15-AUG-89	1835	260.0	5.1	7.2	25.2	5.2	256	1.7	0.1
60 00NF02ZM0074	15-AUG-89	1840	260.0	5.1	7.2	25.2	5.1	257	1.6	0.3
61 00NF02ZM0074	15-AUG-89	1845	260.0	5.1	7.2	25.2	5.1	259	1.8	0.1
62 OUTFLOW-WATERFORD										
63 00NF02ZM0094	15-AUG-89	1250	780.0	7.0	7.7	19.8	6.9	1080	0.5	18.3
64 WATERFORD RIVER										
65 00NF02ZM0093	15-AUG-89	1220	640.0	7.1	9.0	20.5	6.9	635	0.7	15.6

STATION	APPARENT COLOUR REL UNITS	DISS CALCIUM MG/L	DISS MAGNES MG/L	DISS POTASS MG/L	DISS SODIUM MG/L	DISS CHLORIDE MG/L	DISS SULPHATE MTB MG/L	DISS SULPHATE MG/L	TOTAL PHOSPH MG/L	EXTRBLE COPPER MG/L
48 00NF02ZM0008	30	12.7	3.40	1.24	48.0	99.0	5.1	4.5	0.033	L.002
49 00NF02ZM0096	20	5.9	1.80	0.76	50.0	78.0	3.7	3.4	0.052	0.003
50 00NF02ZM0090	10	15.3	3.50	1.00	53.1	92.0	7.1	6.7	0.047	L.002
51 WATERFORD RIVER										
52 00NF02ZM0091	5	17.1	3.50	1.90	85.0	139.0	10.5	9.9	0.041	L.002
53 TRIBUTARY BEAVER BROOK										
54 00NF02ZM0095	20	2.8	1.20	0.37	25.0	43.0	5.8	5.5	0.008	L.002
55 WATERFORD RIVER										
56 00NF02ZM0092	5	16.7	3.50	2.10	91.0	167.0	11.2	11.2	0.060	L.002
57 29NF02ZM0097	30	6.3	1.30	4.30	43.0	57.0	11.9	10.2	1.500	0.015
58 TRIBUTARY MUNDY POND										
59 00NF02ZM0074	110	11.5	1.50	0.72	38.0	82.0	3.1	2.3	0.011	L.002
60 00NF02ZM0074	110	11.5	1.50	0.73	38.0	82.0	3.1	2.3	0.011	L.002
61 00NF02ZM0074	110	11.5	1.50	0.75	37.6	80.0	3.1	2.3	0.011	L.002
62 OUTFLOW-WATERFORD										
63 00NF02ZM0094	5	26.7	6.10	3.00	176.0	320.0	28.0	27.5	0.033	0.007
64 WATERFORD RIVER										
65 00NF02ZM0093	5	17.6	3.50	2.40	97.6	174.0	12.0	11.8	0.180	0.003

TABLE 2
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES
MAJOR IONS, METALS AND NUTRIENTS

STATION	EXTRBLE ZINC MG/L	EXTRBLE CADIUM MG/L	EXTRBLE LEAD MG/L	EXTRBLE ALUMINUM MG/L	EXTRBLE IRON MG/L	EXTRBLE MANGAN MG/L	DISS ORG CARBON MG/L	DISS NITRO NO3,NO2 MG/L	TOTAL NITRO MG/L	SILICA (MB) MG/L
48 00NF02ZM0008	0.02	L.001	L.002	0.035	0.76	0.41	4.8	0.230	0.43	5.2
49 00NF02ZM0096	0.01	L.001	L.002	0.210	0.54	0.46	4.1	0.130	0.26	4.9
50 00NF02ZM0090	L.01	L.001	L.002	0.017	0.16	0.05	2.7	0.530	0.69	5.3
51 WATERFORD RIVER										
52 00NF02ZM0091	0.01	L.001	L.002	0.016	0.13	0.07	2.5	0.640	0.84	4.8
53 TRIBUTARY BEAVER BROOK										
54 00NF02ZM0095	L.01	L.001	L.002	0.140	0.27	0.03	4.4	0.040	0.24	1.0
55 WATERFORD RIVER										
56 00NF02ZM0092	0.01	L.001	0.002	0.024	0.14	0.06	2.5	0.670	0.87	4.8
57 29NF02ZM0097	0.03	L.001	0.007	0.110	0.24	0.08	3.2	0.009	3.20	3.4
58 TRIBUTARY MUNDY POND										
59 00NF02ZM0074	L.01	L.001	L.002	0.180	2.80	0.78	6.5	0.009	0.28	2.6
60 00NF02ZM0074	0.01	L.001	L.002	0.190	3.10	0.76	6.3	0.009	0.28	2.6
61 00NF02ZM0074	0.01	L.001	L.002	0.170	2.90	0.78	6.2	0.009	0.26	2.6
62 OUTFLOW-WATERFORD										
63 00NF02ZM0094	0.07	L.001	0.002	0.015	0.19	0.11	2.5	0.150	0.50	3.8
64 WATERFORD RIVER										
65 00NF02ZM0093	0.02	L.001	L.002	0.022	0.34	0.16	0.5	0.620	1.00	4.6

STATION	EXTRBLE MERCURY UG/L
48 00NF02ZM0008	L.02
49 00NF02ZM0096	L.02
50 00NF02ZM0090	L.02
51 WATERFORD RIVER	
52 00NF02ZM0091	L.02
53 TRIBUTARY BEAVER BROOK	
54 00NF02ZM0095	0.02
55 WATERFORD RIVER	
56 00NF02ZM0092	L.02
57 29NF02ZM0097	0.14
58 TRIBUTARY MUNDY POND	
59 00NF02ZM0074	L.02
60 00NF02ZM0074	L.02
61 00NF02ZM0074	L.02
62 OUTFLOW-WATERFORD	
63 00NF02ZM0094	L.02
64 WATERFORD RIVER	
65 00NF02ZM0093	L.02

TABLE 3
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES
MAJOR IONS, METALS AND NUTRIENTS AT SHORT-TERM
PRESURVEY HEADWATER SITES

STATION	SAMPLE DATE	TEMP FIELD DEG.C.	PH FIELD PH UNITS	SP COND FIELD USIE/CM	DISS OXYGEN MG/L	DISS CALCIUM MG/L	DISS MAGNESIUM MG/L	DISS SODIUM MG/L	DISS POTASS MG/L	DISS CHLORIDE MG/L
1 BREMIGANS PONDS										
2 OONF02ZM0072	27-FEB-89	0.6	5.5	100.2	12.2	2.03	0.96	12.90	0.45	22.20
3 OONF02ZM0072	29-MAR-89	0.1	5.5	132.6	11.2	2.70	1.30	16.40	0.55	30.00
4 OONF02ZM0072	21-APR-89	4.6	5.5	193.1	12.1	3.30	1.30	24.00	0.58	43.60
5 OONF02ZM0072	25-MAY-89	17.4	5.9	175.6	8.1	4.10	1.50	26.70	0.68	48.30
6 OONF02ZM0072	25-MAY-89	17.4	5.9	175.6	8.1	4.10	1.50	26.40	0.63	48.30
7 OONF02ZM0072	25-MAY-89	17.4	5.9	175.6	8.1	4.10	1.50	28.00	0.63	48.30
8 OONF02ZM0072	27-JUN-89	23.0	5.9	125.0	7.7	3.10	1.20	19.00	0.31	34.00
9 OONF02ZM0072	25-JUL-89	16.7	6.1	133.9	8.4	4.20	1.50	26.00	0.25	44.00
10 TRIBUTARY-DONAVANS PARK										
11 OONF02ZM0073	29-MAR-89	0.1	5.1	104.4	12.1	2.00	1.20	12.10	0.47	23.00
12 OONF02ZM0073	21-APR-89	4.7	5.0	105.6	11.6	1.90	1.00	11.50	0.46	22.00
13 OONF02ZM0073	25-MAY-89	15.1	5.2	97.0	8.4	2.30	1.20	13.10	0.42	24.70
14 OONF02ZM0073	27-JUN-89	19.1	5.0	69.3	7.6	1.70	0.81	9.10	0.22	18.90
15 OONF02ZM0073	25-JUL-89	15.2	5.2	94.4	6.8	3.20	1.50	16.80	0.33	29.00
16 OONF02ZM0073	25-JUL-89	15.2	5.2	94.4	6.8	3.20	1.50	18.00	0.33	29.00
17 OONF02ZM0073	25-JUL-89	15.2	5.2	94.4	6.8	3.20	1.50	18.00	0.34	29.00
18 TRIBUTARY- SOUTH BROOK										
19 OONF02ZM0001	27-FEB-89	0.5	5.5	44.3	13.5	1.09	0.61	5.11	0.33	8.88
20 OONF02ZM0001	27-MAR-89	0.1	5.4	43.5	12.1	0.88	0.63	4.70	0.34	8.10
21 OONF02ZM0001	25-APR-89	9.2	5.3	36.3	10.9	0.72	0.49	4.50	0.37	6.50
22 OONF02ZM0001	25-MAY-89	19.6	6.1	40.1	8.7	1.00	0.57	5.10	0.29	7.80
23 OONF02ZM0001	28-JUN-89	20.8	5.9	34.5	8.1	1.00	0.54	5.20	0.20	7.20
24 OONF02ZM0001	25-JUL-89	17.5	6.5	29.7	8.7	1.20	0.53	5.10	0.17	7.40
25 TRIBUTARY- MUNDY POND										
26 OONF02ZM0074	30-MAR-89	0.2	4.9	375.0	10.3	5.20	1.50	50.00	0.91	86.00
27 OONF02ZM0074	25-APR-89	11.2	5.0	217.0	10.7	3.00	0.96	31.60	0.79	53.00
28 OONF02ZM0074	25-MAY-89	24.3	5.0	266.0	8.1	5.60	1.50	38.50	0.81	77.00
29 OONF02ZM0074	28-JUN-89	23.6	5.0	211.0	7.3	3.80	1.10	17.00	0.40	66.00
30 OONF02ZM0074	25-JUL-89	19.9	5.1	158.4	8.9	4.20	1.20	36.00	0.26	64.00
31 TRIBUTARY- KITTY GAULD B										
32 OONF02ZM0075	30-MAR-89	0.4	5.1	70.7	13.4	1.10	0.98	7.50	0.46	13.70
33 OONF02ZM0075	25-APR-89	5.2	4.9	57.7	12.2	0.83	0.68	6.90	0.42	10.30
34 OONF02ZM0075	25-MAY-89	15.2	5.4	56.4	9.5	1.30	0.81	7.00	0.39	12.00
35 OONF02ZM0075	28-JUN-89	14.2	5.3	39.9	9.5	0.93	0.67	6.60	0.19	12.40
36 OONF02ZM0075	25-JUL-89	14.0	5.8	41.9	9.3	1.20	0.70	7.20	0.23	11.00

TABLE 3
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES
MAJOR IONS, METALS AND NUTRIENTS AT SHORT-TERM
PRESURVEY HEADWATER SITES

STATION	DISS SULPHATE MRB MG/L	DISS SULPHATE MG/L	TOTAL ALKALIN MG/L	SILICA (MB) MG/L	PH LAB PH UNITS	SP COND LAB USIE/CM	TURB JTU	APPARENT COLOUR REL UNITS	DISS ORG CARBON MG/L
1 BREMIGANS PONDS									
2 00NF02ZM0072	4.7	4.21	1.0	3.69	5.55	118.0	0.50	10	2.9
3 00NF02ZM0072	4.5	4.60	1.9	4.40	5.80	121.0	0.30	10	2.1
4 00NF02ZM0072	5.5	4.90	0.4	3.20	5.50	162.0	0.30	5	2.8
5 00NF02ZM0072	4.4	4.30		2.10	6.10	179.0	0.50	15	2.0
6 00NF02ZM0072	4.6	4.20	2.2	2.10	6.00	179.0	0.50	15	2.2
7 00NF02ZM0072	4.1	4.20	2.2	2.20	5.90	180.0	0.50	25	2.0
8 00NF02ZM0072	3.5	3.20		3.60	6.40	130.0	0.50	35	3.0
9 00NF02ZM0072	3.2	2.90		3.60	6.10	179.0	0.60	20	1.8
10 TRIBUTARY-DONAVANS PARK									
11 00NF02ZM0073	3.5	3.20	0.7	4.60	5.20	94.0	0.30	30	3.2
12 00NF02ZM0073	3.8	2.80	-0.1	3.30	5.10	88.0	0.40	30	3.9
13 00NF02ZM0073	2.7	2.30	0.9	3.10	5.40	96.0	0.50	50	4.6
14 00NF02ZM0073	3.6	1.80	1.0	3.40	5.10	71.0	0.70	120	9.5
15 00NF02ZM0073	2.4	1.20	0.8	4.90	5.30	124.0	0.60	100	6.4
16 00NF02ZM0073	2.4	1.20	1.1	4.90	5.30	125.0	0.70	100	6.3
17 00NF02ZM0073	2.4	1.10	0.9	5.00	5.30	123.0	0.80	100	6.2
18 TRIBUTARY- SOUTH BROOK									
19 00NF02ZM0001	3.6	2.57	0.9	3.58	5.58	49.3	0.48	20	3.7
20 00NF02ZM0001	2.7	2.70	2.3	4.40	5.90	41.0	0.40	20	2.9
21 00NF02ZM0001	3.3	2.70	0.1	2.70	5.30	35.0	0.30	25	4.1
22 00NF02ZM0001	2.5	2.20		2.50	6.10	40.0	0.40	25	2.9
23 00NF02ZM0001	2.9	1.60	2.0	3.60	5.80	37.0	0.70	80	6.5
24 00NF02ZM0001	2.5	1.40		4.40	6.30	40.0	0.70	60	4.6
25 TRIBUTARY- MUNDY POND									
26 00NF02ZM0074	6.3	6.30	0.2	4.70	4.90	318.0	0.50	15	2.3
27 00NF02ZM0074	6.5	5.70	-0.1	2.60	5.10	203.0	0.50	20	4.4
28 00NF02ZM0074	4.1	4.20	-0.1	0.60	5.10	270.0	0.80	30	2.9
29 00NF02ZM0074	4.8	4.50	0.2	3.10	5.00	221.0	0.90	45	4.1
30 00NF02ZM0074	3.2	3.50	0.1	2.40	5.20	239.0	1.20	60	4.8
31 TRIBUTARY- KITTY GAULD B									
32 00NF02ZM0075	4.4	4.10	0.5	4.80	5.10	63.0	0.40	5	2.1
33 00NF02ZM0075	4.4	4.30	-0.3	3.20	5.00	52.0	0.40	10	3.1
34 00NF02ZM0075	4.1	3.90	0.2	2.90	5.40	56.0	0.20	5	2.1
35 00NF02ZM0075	4.3	3.90	-0.3	3.20	5.20	52.0	0.30	20	3.5
36 00NF02ZM0075	3.7	3.40	0.5	4.60	5.60	56.0	0.30	5	2.1

TABLE 3
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES
MAJOR IONS, METALS AND NUTRIENTS AT SHORT-TERM
PRESURVEY HEADWATER SITES

STATION	NITROGEN NITRATE IC MG/L	TOTAL PHOSPH MG/L	TOTAL NITRO MG/L	TOTAL ALUMINUM MG/L	TOTAL CADMIUM MG/L	TOTAL COPPER MG/L	TOTAL IRON MG/L	TOTAL MANGANESE MG/L	TOTAL LEAD MG/L	TOTAL ZINC MG/L
1 BREMIGANS PONDS										
2 00NF02ZM0072	0.02	0.0056	0.146	0.129	L.002	L.002	0.299	0.1640	L.002	0.0042
3 00NF02ZM0072	0.06	0.0030	L.1	0.080	L.002	0.0020	0.180	0.2100	L.002	0.0000
4 00NF02ZM0072	0.04	0.0030	L.1	0.085	L.002	L.002	0.260	0.1500	L.002	0.0000
5 00NF02ZM0072	L.01	0.0040	0.120	0.056	L.002	L.002	0.410	0.5000	L.002	0.0000
6 00NF02ZM0072	L.01	0.0040	0.120	0.055	L.002	L.002	0.420	0.5100	L.002	0.0000
7 00NF02ZM0072	L.01	0.0060	0.110	0.051	L.002	L.002	0.430	0.5100	L.002	0.0000
8 00NF02ZM0072	L.01	0.0080	0.240	0.083	L.002	L.002	0.690	0.4200	L.002	0.0000
9 00NF02ZM0072	L.01	0.0050	0.100	0.032	L.002	L.002	0.590	0.3700	L.002	0.0000
10 TRIBUTARY-DONAVANS PARK										
11 00NF02ZM0073	0.05	0.0020	L.1	0.120	L.002	L.002	0.330	0.0700	L.002	L.01
12 00NF02ZM0073	0.01	0.0030	L.1	0.140	L.002	L.002	0.400	0.0600	L.002	L.01
13 00NF02ZM0073	L.01	0.0060	0.170	0.130	L.002	L.002	0.630	0.0900	L.002	L.01
14 00NF02ZM0073	L.01	0.0110	0.330	0.250	L.002	L.002	0.750	0.0800	L.002	L.01
15 00NF02ZM0073	L.01	0.0130	0.170	0.210	L.002	L.002	1.200	0.1800	L.002	L.01
16 00NF02ZM0073	L.01	0.0090	0.170	0.210	L.002	L.002	1.200	0.1800	L.002	L.01
17 00NF02ZM0073	L.01	0.0100	0.170	0.210	L.002	L.002	1.200	0.1900	L.002	L.01
18 TRIBUTARY- SOUTH BROOK										
19 00NF02ZM0001	0.03	0.0054	0.184	0.145	L.002	0.0004	0.183	0.0768	L.002	0.0022
20 00NF02ZM0001	0.05	0.0040	0.100	0.120	L.002	0.0020	0.260	0.0500	L.002	L.01
21 00NF02ZM0001	L.01	0.0040	L.1	0.130	L.002	L.002	0.200	0.0500	L.002	L.01
22 00NF02ZM0001	L.01	0.0060	0.160	0.100	L.002	L.002	0.410	0.0500	L.002	L.01
23 00NF02ZM0001	0.01	0.0110	0.330	0.190	L.002	L.002	0.560	0.0900	L.002	L.01
24 00NF02ZM0001	L.01	0.0100	0.180	0.110	L.002	L.002	0.850	0.1200	L.002	L.01
25 TRIBUTARY- MUNDY POND										
26 00NF02ZM0074	0.08	0.0020	0.120	0.220	L.002	L.002	0.470	0.3700	L.002	0.0200
27 00NF02ZM0074	0.02	0.0040	L.1	0.220	L.002	L.002	0.330	0.2100	L.002	L.01
28 00NF02ZM0074	L.01	0.0060	0.150	0.160	L.002	L.002	1.200	0.6200	L.002	0.0100
29 00NF02ZM0074	L.01	0.0090	0.280	0.180	L.002	L.002	0.920	0.4700	L.002	0.0100
30 00NF02ZM0074	L.01	0.0060	0.190	0.140	L.002	L.002	1.900	0.7100	L.002	L.01
31 TRIBUTARY- KITTY GAULD B										
32 00NF02ZM0075	0.07	0.0030	L.1	0.190	L.002	L.002	0.220	0.2000	L.002	L.01
33 00NF02ZM0075	0.01	0.0030	L.1	0.200	L.002	L.002	0.100	0.0900	L.002	L.01
34 00NF02ZM0075	L.01	0.0020	0.100	0.094	L.002	L.002	0.070	0.0700	L.002	L.01
35 00NF02ZM0075	L.01	0.0060	0.230	0.190	L.002	L.002	0.180	0.1200	L.002	L.01
36 00NF02ZM0075	0.02	0.0030	0.120	0.093	L.002	L.002	0.150	0.1400	L.002	L.01

TABLE 3
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES
MAJOR IONS, METALS AND NUTRIENTS AT SHORT-TERM
PRESURVEY HEADWATER SITES

STATION	EXTRBLE MERCURY UG/L
1 BREMIGANS PONDS	
2 00NF02ZM0072	L.02
3 00NF02ZM0072	L.02
4 00NF02ZM0072	L.02
5 00NF02ZM0072	L.02
6 00NF02ZM0072	L.02
7 00NF02ZM0072	L.02
8 00NF02ZM0072	L.02
9 00NF02ZM0072	L.02
10 TRIBUTARY-DONAVANS PARK	
11 00NF02ZM0073	L.02
12 00NF02ZM0073	L.02
13 00NF02ZM0073	L.02
14 00NF02ZM0073	L.02
15 00NF02ZM0073	L.02
16 00NF02ZM0073	L.02
17 00NF02ZM0073	L.02
18 TRIBUTARY- SOUTH BROOK	
19 00NF02ZM0001	L.02
20 00NF02ZM0001	L.02
21 00NF02ZM0001	L.02
22 00NF02ZM0001	L.02
23 00NF02ZM0001	L.02
24 00NF02ZM0001	L.02
25 TRIBUTARY- MUNDY POND	
26 00NF02ZM0074	L.02
27 00NF02ZM0074	L.02
28 00NF02ZM0074	L.02
29 00NF02ZM0074	L.02
30 00NF02ZM0074	L.02
31 TRIBUTARY- KITTY GAULD B	
32 00NF02ZM0075	L.02
33 00NF02ZM0075	L.02
34 00NF02ZM0075	L.02
35 00NF02ZM0075	L.02
36 00NF02ZM0075	L.02

TABLE 4
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER COLIFORM BACTERIA CONCENTRATIONS
No./100ml

STATION	SAMPLE DATE	SAMPLE TIME	TOTAL COLIFORM No./100mL	FECAL COLIFORM No./100mL
1 BREMIGANS POND				
2 00NF02ZM0076	08-AUG-89	1130	20	20
3 00NF02ZM0072	08-AUG-89	1300	40	20
4 00NF02ZM0078	09-AUG-89	1000	G1600.	G600.
5 BRAZIL POND				
6 00NF02ZM0077	08-AUG-89	1615	100	40
7 00NF02ZM0079	09-AUG-89	1020	340	140
8 TRIBUTARY ELIZABETH PARK				
9 00NF02ZM0080	09-AUG-89	1110	G1600.	G600.
10 WATERFORD RIVER				
11 00NF02ZM0081	09-AUG-89	1140	G1600.	G600.
12 TRIBUTARY DONAVANS PARK				
13 00NF02ZM0073	09-AUG-89	1400	300	270
14 00NF02ZM0082	09-AUG-89	1500	G1600.	G600.
15 WATERFORD RIVER				
16 00NF02ZM0003	15-AUG-89	1840	G1600.	G600.
17 TRIBUTARY GLENDALE				
18 00NF02ZM0083	09-AUG-89	1630	1200	440
19 WATERFORD RIVER				
20 00NF02ZM0004	15-AUG-89	1825	G1600.	G600.
21 TRIBUTARY BRANSCOMBS PON				
22 00NF02ZM0087	15-AUG-89	1745	120	250
23 WATERFORD RIVER				
24 00NF02ZM0012	15-AUG-89	1710	G1600.	500
25 TRIBUTARY MOUNT PEARL				
26 00NF02ZM0086	15-AUG-89	1740	160	160
27 WATERFORD RIVER				
28 00NF02ZM0085	15-AUG-89	1735	G1600.	350
29 TRIBUTARY EXPERIMENTAL F				
30 00NF02ZM0088	15-AUG-89	1625	120	40
31 00NF02ZM0006	15-AUG-89	1635	G1600.	G600.
32 00NF02ZM0084	15-AUG-89	1730	G1600.	G600.
33 TRIBUTARY KITTY GAULD BR				
34 00NF02ZM0075	15-AUG-89	1905	G1600	10.0
35 WATERFORD RIVER				
36 00NF02ZM0089	14-AUG-89	1125	G1600.	G600.
37 TRIBUTARY SOUTH BROOK				
38 00NF02ZM0001	15-AUG-89	1620	40	10
39 00NF02ZM0007	15-AUG-89	1615	140	50
40 00NF02ZM0008	15-AUG-89	1600	G1600.	G600.
41 00NF02ZM0096	15-AUG-89	1530	G1600.	G600.
42 00NF02ZM0090	14-AUG-89	1300	1300	G600.
43 WATERFORD RIVER				
44 00NF02ZM0091	14-AUG-89	1445	G1600.	G600.

TABLE 4

WATERFORD RIVER BASIN RECURRENT SURVEY 1989

SURFACE WATER COLIFORM BACTERIA CONCENTRATIONS

No./100ml

STATION	SAMPLE DATE	SAMPLE TIME	TOTAL COLIFORM No./100mL	FECAL COLIFORM No./100mL
45 TRIBUTARY BEAVER BROOK				
46 00NF02ZM0095	15-AUG-89	1450	80	60
47 WATERFORD RIVER				
48 00NF02ZM0092	14-AUG-89	1615	1000	G600.
49 29NF02ZM0097	15-AUG-89	1330	G1600.	G600.
50 TRIBUTARY MUNDY POND				
51 00NF02ZM0074	15-AUG-89	1835	G1600.	L10.
52 00NF02ZM0094	15-AUG-89	1250	G1600.	G600.
53 WATERFORD RIVER				
54 00NF02ZM0093	15-AUG-89	1220	G1600.	G600.

TABLE 5

WATERFORD RIVER BASIN RECURRENT SURVEY 1989

SURFACE WATER ANALYSIS OF CHLORINATED HYDROCARBONS, CHLORINATED BENZENES, POLYNUCLEAR AROMATIC HYDROCARBONS, AND CHLORINATED PHENOLS IN NG/L

	STATION	SAMPLE	SAMPLE DATE	STIME	ALPHA BHC	GAMMA BHC	HEPTA-CHLOR	ALDRIN	HEPTA-CHLOR-EPOXIDE	GAMMA CHLORDANE	ALPHA CHLORDANE
1	00NF02ZM0081	905587	09-AUG-89	1140	0.45	L.4	L.4	L.4	L.4	L.4	L.4
2	00NF02ZM0082	905588	09-AUG-89	1430	0.48	0.53	L.4	L.4	L.4	L.4	L.4
3	00NF02ZM0003	905589	10-AUG-89	1040	L.4	L.4	L.4	L.4	L.4	L.4	L.4
4	00NF02ZM0004	905590	10-AUG-89	1140	0.61	0.49	L.4	L.4	L.4	L.4	L.4
5	00NF02ZM0085	905593	10-AUG-89	1600	0.63	0.44	L.4	L.4	L.4	L.4	L.4
6	00NF02ZM0084	905592	10-AUG-89	1400	L.4	L.4	L.4	L.4	L.4	L.4	L.4
7	00NF02ZM0089	905594	14-AUG-89	1115	0.55	0.49	L.4	L.4	L.4	L.4	L.4
8	00NF02ZM0001	905591	10-AUG-89	1215	0.45	L.4	L.4	L.4	L.4	L.4	L.4
9	00NF02ZM0090	905599	14-AUG-89	1300	0.48	0.44	L.4	L.4	L.4	L.4	L.4
10	00NF02ZM0092	905600	14-AUG-89	1630	0.43	L.4	L.4	L.4	L.4	L.4	L.4

	ALPHA ENDOSULFAN	PP-DDE	HEOD\ DIELDRIN	ENDRIN	OP-DDT	PP-TDE	PP-DDT	BETA-ENDO-SULFAN	MIREX	METHOXY CHLOR	TOTAL PCB'S
1	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9
2	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9
3	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9
4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9
5	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9
6	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9
7	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9
8	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9
9	L.4	L.4	0.58	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9
10	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9

	1,3 DI-CHLORO-BENZENE	1,4 DI-CHLORO-BENZENE	1,2 DI-CHLORO-BENZENE	1,3,5 TRI-CHLORO-BENZENE	1,2,4 TRI-CHLORO-BENZENE	1,2,3 TRI-CHLORO-BENZENE	1,2,3,4 TETRA-CHLORO-BENZENE	HEXA-CHLORO-BENZENE	PENTA-CHLORO-BENZENE	INDENE
1	L5	5.31	L5	L1	L1	L1	L1	L.4	L1	L10
2	L5	5.59	L5	L1	L1	L1	L1	L.4	L1	L10
3	L5	6.80	L5	L1	L1	L1	L1	L.4	L1	L10
4	L5	8.69	5.06	L1	L1	L1	L1	L.4	L1	L10
5	L5	6.15	L5	L1	L1	L1	L1	L.4	L1	L10
6	L5	L5	5.07	L1	L1	L1	L1	L.4	L1	L10
7	L5	8.63	L5	L1	L1	L1	L1	L.4	L1	L10
8	L5	5.84	L5	L1	L1	L1	L1	L.4	L1	L10
9	L5	5.79	5.12	L1	L1	L1	L1	L.4	L1	L10
10	L5	L5	L5	L1	L1	L1	L1	L.4	L1	L10

TABLE 5
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER ANALYSIS OF CHLORINATED HYDROCARBONS,
CHLORINATED BENZENES, POLYNUCLEAR AROMATIC HYDROCARBONS, AND
CHLORINATED PHENOLS IN NG/L

	1,2,3,4-TETRAHYDRO-NAPHTALENE	2-METHYL-NAPHTA-LENE	1-METHYL-NAPHTA-LENE	B-CHLORO-NAPHTA-LENE	ACENAPH-THYLENE	ACENAPH-THENE	FLUORENE	PHENAN-THRENE	PYRENE	FLUOR-ANTHENE
1	L10	L10	L10	L10	L10	L10	L15	L15	L15	L15
2	L10	L10	L10	L10	L10	L10	L15	L15	L15	L15
3	L10	L10	L10	L10	L10	L10	L15	L15	L15	L15
4	L10	L10	L10	L10	L10	L10	L15	L15	L15	L15
5	L10	L10	L10	L10	L10	L10	L15	L15	38.2	L15
6	L10	L10	L10	L10	L10	L10	L15	L15	L15	L15
7	L10	L10	L10	L10	L10	L10	L15	L15	L15	L15
8	L10	L10	L10	L10	L10	L10	L15	L15	L15	L15
9	L10	L10	L10	L10	L10	L10	L15	L15	L15	L15
10	L10	L10	L10	L10	L10	L10	L15	L15	L15	L15

	BENZO(b)-FLUOR-ANTHENE	BENZO(k)-FLUOR-ANTHENE	BENZO(a)-PYRENE	INDENO-(1,2,3-cd) PYRENE	BENZO(g,h,i) PERYLENE	O-CHLORO-PHENOL	M-CHLORO-PHENOL	P-CHLORO-PHENOL	2 CL-5-METHYL-PHENOL	2,6 DI-CHLORO-PHENOL
1	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
2	31.9	L30	L30	L30	L30	L65	L50	L40	L105	L55
3	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
4	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
5	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
6	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
7	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
8	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
9	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
10	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55

	3 MET-4 CHLORO-PHENOL	2,4 DI-CHLORO-PHENOL	3,5 DI-CHLORO-PHENOL	2,3 DI-CHLORO-PHENOL	3,4 DI-CHLORO-PHENOL	2,4,6 TRI-CHLORO-PHENOL	2,3,6 TRI-CHLORO-PHENOL	2,3,5 TRI-CHLORO-PHENOL	2,4,5 TRI-CHLORO-PHENOL	2,3,4 TRI-CHLORO-PHENOL
1	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
2	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
3	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
4	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
5	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
6	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
7	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
8	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
9	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
10	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60

TABLE 5
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
SURFACE WATER ANALYSIS OF CHLORINATED HYDROCARBONS,
CHLORINATED BENZENES, POLYNUCLEAR AROMATIC HYDROCARBONS, AND
CHLORINATED PHENOLS IN NG/L

	3,4,5 TRI-CHLORO-PHENOL	2,3,5,6 TETRACHLORO-PHENOL	2,3,4,6 TETRACHLORO-PHENOL	2,3,4,5 TETRACHLORO-PHENOL	PENTA-CHLORO-PHENOL
1	L70	L80	L60	L90	L85
2	L70	L80	L60	L90	L85
3	L70	L80	L60	L90	L85
4	L70	L80	L60	L90	L85
5	L70	L80	L60	L90	L85
6	L70	L80	L60	L90	L85
7	L70	L80	L60	L90	L85
8	L70	L80	L60	L90	L85
9	L70	L80	L60	L90	L85
10	L70	L80	L60	L90	L85

TABLE 6

WATERFORD RIVER BASIN RECURRENT SURVEY 1989

SEDIMENT ANALYSIS OF PARTICLE SIZE (%), ORGANIC CONTENT (%)

METALS (MG/KG), AND OIL CONTENT (%)

	STATION	SAMPLE DATE	SAMPLE TIME	SAND %	SILT %	CLAY %	O.CARBON PARTIC %	O.NITRO PARTIC %	EXTRBLE ALUMINUM MG/KG	EXTRBLE CADIUM MG/KG	EXTRBLE COBALT MG/KG	EXTRBLE CHROMIUM MG/KG
1	51NF02ZM0100	08-AUG-89	1330				18.40	1.53	7380	L.200	40.20	2.34
2	51NF02ZM0101	08-AUG-89	1600				18.10	1.84	6830	0.364	7.33	2.15
3	50NF02ZM0084	10-AUG-89	1400				17.30	1.50	7660	0.619	25.90	7.40
4	50NF02ZM0084	10-AUG-89	1405				18.90	1.60	7290	0.914	20.20	4.81
5	50NF02ZM0009	14-AUG-89	1530	82.0	11.3	6.7	0.17	0.04	5400	L.200	7.39	6.57
6	50NF02ZM0009	14-AUG-89	1535				0.15	0.03	5230	L.200	7.90	5.79
7	50NF02ZM0009	14-AUG-89	1540				0.14	0.03	5300	0.221	7.14	5.84
8	51NF02ZM0103	15-AUG-89	1100				9.72	1.00	19600	0.438	10.80	5.93
9	51NF02ZM0103	15-AUG-89	1105				9.59	0.98	12400	L.200	5.92	3.05
10	51NF02ZM0103	15-AUG-89	1110				3.56	0.38	18600	0.373	8.58	5.04
11	51NF02ZM0102	11-AUG-89	1300	14.2	59.4	26.4	7.62	0.73	13300	3.510	27.10	59.90
12	51NF02ZM0102	11-AUG-89	1305				7.51	0.73	12600	3.450	26.90	48.90
13	51NF02ZM0102	11-AUG-89	1310				7.81	0.78	12600	3.090	26.50	52.90
14	53NF02ZM0104	11-AUG-89	1700	42.2	43.0	14.8	5.83	0.51	7240	1.940	10.10	18.30
15	53NF02ZM0104	11-AUG-89	1705				6.27	0.54	5260	1.570	7.39	13.60

	EXTRBLE COPPER MG/KG	NONRESID IRON MG/KG	NONRESID MANGANESE MG/KG	NONRESID NICKEL MG/KG	EXTRBLE LEAD MG/KG	NONRESID ZINC MG/KG	TOTAL MERCURY MG/KG	GREASE-OILS %
1	12.40	23800	3580	1.72	24.3	66.2	0.10	0.16
2	18.20	6670	305	7.37	52.6	70.5	0.09	0.36
3	24.50	13800	655	8.62	34.4	351.0	0.12	0.32
4	24.40	14600	3270	8.22	31.4	592.0	0.07	0.30
5	17.30	12600	930	8.95	18.5	92.7	0.03	L.1
6	13.10	13400	849	7.71	16.6	83.8	0.03	L.1
7	13.60	12800	916	8.00	16.8	84.0	0.03	L.1
8	24.10	7560	231	7.02	78.9	94.4	0.16	0.18
9	16.40	5040	137	6.24	50.2	66.2	0.11	0.21
10	26.50	7860	190	8.62	84.4	112.0	0.18	0.27
11	43.60	33200	1780	23.00	351.0	1060.0	0.36	0.55
12	36.20	31200	1550	22.00	330.0	1060.0	0.35	1.01
13	38.40	32700	1780	23.70	328.0	1020.0	0.36	0.77
14	6.65	17800	207	14.70	193.0	441.0	1.35	0.61
15	17.30	12400	153	10.90	142.0	324.0	1.41	0.46

TABLE 7
WATERFORD RIVER RECURRENT SURVEY 1989
SEDIMENT ANALYSIS OF ORGANIC COMPOUNDS
ORGANOCHLORINES, CHLORINATED BENZENES, POLYNUCLEAR AROMATIC
HYDROCARBONS AND CHLORINATED PHENOLS IN NG/G

STATION	PYRENE	FLUOR-ANTHENE	BENZO(b)-FLUOR-ANTHENE	BENZO(k)-FLUOR-ANTHENE	BENZO(a)-PYRENE	INDENO-PYRENE	BENZO-PERY-LENE	O-CHLORO-PHENOL	M-CHLORO-PHENOL
1 51NF02ZM0100								50	L10.0
2 51NF02ZM0101								L10.0	L10.0
3 50NF02ZM0084	286.0	424.0			109.0	52.8	62.6	L10.0	L10.0
4 50NF02ZM0084	146.0	230.0			84.9	46.6	57.8	L10.0	L10.0
5 50NF02ZM0009	45.8	62.5			L30	L30	L30	L10.0	L10.0
6 50NF02ZM0009	L15	20.7			L30	L30	L30	L10.0	L10.0
7 50NF02ZM0009	L15	L15			L30	L30	L30	L10.0	L10.0
8 51NF02ZM0103	136.0	208.0			151.0	97.2	116.0	L10.0	L10.0
9 51NF02ZM0103	164.0	230.0			142.0	129.0	150.0	L10.0	L10.0
10 51NF02ZM0103	131.0	175.0			94.1	66.7	87.2	L10.0	L10.0
11 51NF02ZM0102	2120.0	2780.0			145.0	638.0	885.0	L10.0	L10.0
12 51NF02ZM0102	514.0	614.0			308.0	252.0	359.0	L10.0	L10.0
13 51NF02ZM0102	211.0	227.0			1260.0	96.7	134.0	L10.0	L10.0
14 53NF02ZM0104	3890.0	10100.0	2410	1690	2630.0	1380.0	1750.0	L10.0	L10.0
15 53NF02ZM0104	4140.0	7270.0	1500	1050	1400.0	617.0	725.0	L10.0	L10.0

STATION	P-CHLORO-PHENOL	2 CL-5-METHYL-PHENOL	2,6 DI-CHLORO-PHENOL	3 MET-4 CHLORO-PHENOL	2,4 DI-CHLORO-PHENOL	3,5 DI-CHLORO-PHENOL	2,3 DI-CHLORO-PHENOL	3,4 DI-CHLORO-PHENOL	2,4,6 TRI-CHLORO-PHENOL
1 51NF02ZM0100	L10.0	L10.0	22.7	L10.0	10.9	L10.0	L10.0	L10.0	11
2 51NF02ZM0101	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
3 50NF02ZM0084	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
4 50NF02ZM0084	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
5 50NF02ZM0009	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
6 50NF02ZM0009	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
7 50NF02ZM0009	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
8 51NF02ZM0103	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
9 51NF02ZM0103	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
10 51NF02ZM0103	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
11 51NF02ZM0102	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
12 51NF02ZM0102	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
13 51NF02ZM0102	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
14 53NF02ZM0104	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0
15 53NF02ZM0104	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0

TABLE 7

WATERFORD RIVER RECURRENT SURVEY 1989

SEDIMENT ANALYSIS OF ORGANIC COMPOUNDS

ORGANOCHLORINES, CHLORINATED BENZENES, POLYNUCLEAR AROMATIC HYDROCARBONS AND CHLORINATED PHENOLS IN NG/G

STATION	2,3,6 TRI-CHLORO-PHENOL	2,3,5 TRI-CHLORO-PHENOL	2,4,5 TRI-CHLORO-PHENOL	2CL4TERB PHENOL	2,3,4 TRI-CHLORO-PHENOL	3,4,5 TRI-CHLORO-PHENOL	2,3,5,6 TET-RACHLORO-PHENOL	2,3,4,6 TET-RACHLORO-PHENOL
1 51NF02ZM0100	L10.0	L10.0	L10.0		L10.0	L10.0	16.7	24.8
2 51NF02ZM0101	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0
3 50NF02ZM0084	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0
4 50NF02ZM0084	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0
5 50NF02ZM0009	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0
6 50NF02ZM0009	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0
7 50NF02ZM0009	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0
8 51NF02ZM0103	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0
9 51NF02ZM0103	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0
10 51NF02ZM0103	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0
11 51NF02ZM0102	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0
12 51NF02ZM0102	L10.0	L10.0	L10.0		10.6	L10.0	L10.0	L10.0
13 51NF02ZM0102	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0
14 53NF02ZM0104	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0
15 53NF02ZM0104	L10.0	L10.0	L10.0		L10.0	L10.0	L10.0	L10.0

STATION	2,3,4,5 TET-RACHLORO-PHENOL	PENTA-CHLORO-PHENOL
1 51NF02ZM0100	15.2	215.3
2 51NF02ZM0101	L10.0	10.8
3 50NF02ZM0084	L10.0	L10.0
4 50NF02ZM0084	L10.0	19.8
5 50NF02ZM0009	L10.0	L10.0
6 50NF02ZM0009	L10.0	L10.0
7 50NF02ZM0009	L10.0	L10.0
8 51NF02ZM0103	L10.0	L10.0
9 51NF02ZM0103	L10.0	L10.0
10 51NF02ZM0103	L10.0	L10.0
11 51NF02ZM0102	L10.0	20.6
12 51NF02ZM0102	L10.0	19.5
13 51NF02ZM0102	L10.0	14.9
14 53NF02ZM0104	11.7	37.2
15 53NF02ZM0104	11.6	44.6

TABLE 8
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
FORAGE FISH ANALYSIS OF ORGANOCHLORINES, CHLORINATED
BENZENES, POLYNUCLEAR AROMATIC HYDROCARBONS IN NG/G,
METALS IN MG/KG, AND PERCENT LIPID CONTENT

STATION	SAMPLE	SAMPLE DATE	SAMPLE TIME	ALPHA BHC	GAMMA BHC	HEPTA-CHLOR	ALDRIN	HEPTA-CHLOR-EPOXIDE	GAMMA CHLORDANE	ALPHA CHLORDANE
1 90NF02ZM0082	905605	09-AUG-89	1430	L5	L5	L5	L5	L5	L5	L5
2 90NF02ZM0003	905606	10-AUG-89	1000	L5	L5	L5	L5	L5	L5	L5
3 90NF02ZM0003	905607	10-AUG-89	1005	L5	L5	L5	L5	L5	L5	L5
4 90NF02ZM0089	905609	14-AUG-89	1135	L5	L5	L5	L5	L5	L5	L5
5 90NF02ZM0109	905608	11-AUG-89	1300							

STATION	ALPHA ENDOSULFAN	PP-DDE	HEOD\ DIELDRIN	ENDRIN	OP-DDT	PP-TDE	PP-DDT	BETA-ENDO-SULFAN	MIREX	METHOXY CHLOR
1 90NF02ZM0082	L5	L5	L5	L5	L5	L5	L5	L5	L5	L5
2 90NF02ZM0003	L5	L5	L5	L5	L5	L5	L5	L5	L5	L5
3 90NF02ZM0003	L5	5.14	L5	L5	L5	L5	L5	L5	L5	L5
4 90NF02ZM0089	L5	8.30	10.5	L5	L5	15.1	L5	L5	L5	L5
5 90NF02ZM0109										

STATION	TOTAL PCB'S	1,3 DI-CHLORO-BENZENE	1,4 DI-CHLORO-BENZENE	1,2 DI-CHLORO-BENZENE	1,3,5 TRI-CHLORO-BENZENE	1,2,4 TRI-CHLORO-BENZENE	1,2,3 TRI-CHLORO-BENZENE	1,2,3,4 TETRA-CHLORO-BENZENE	HEXA-CHLORO-BENZENE
1 90NF02ZM0082	L90	L50	L50	L50	L5	L5	L5	L5	L5
2 90NF02ZM0003	L90	L50	L50	L50	L5	L5	L5	L5	L5
3 90NF02ZM0003	L90	L50	L50	L50	L5	L5	L5	L5	L5
4 90NF02ZM0089	106	L50	L50	L50	L5	L5	L5	L5	L5
5 90NF02ZM0109									

STATION	PENTA-CHLORO-BENZENE	INDENE	1,2,3,4-TETRAHYDRO-NAPHTALENE	2-METHYL-NAPHTA-LENE	1-METHYL-NAPHTA-LENE	B-CHLORO-NAPHTA-LENE	ACENAPH-THYLENE	ACENAPH-THENE	FLUORENE
1 90NF02ZM0082	L5	L10	L10	10.6	L10	L10	L10	L10	L15
2 90NF02ZM0003	L5	L10	L10	L10	L10	L10	L10	L10	L15
3 90NF02ZM0003	L5	L10	L10	13.1	L10	L10	L10	L10	L15
4 90NF02ZM0089	L5	L10	L10	L10	L10	L10	L10	L10	L15
5 90NF02ZM0109									

TABLE 8

WATERFORD RIVER BASIN RECURRENT SURVEY 1989

FORAGE FISH ANALYSIS OF ORGANOCHLORINES, CHLORINATED BENZENES, POLYNUCLEAR AROMATIC HYDROCARBONS IN NG/G, METALS IN MG/KG, AND PERCENT LIPID CONTENT

STATION	PHENAN-THRENE	PYRENE	FLUOR-ANTHENE	BENZO(b)-FLUOR-ANTHENE	BENZO(k)-FLUOR-ANTHENE	BENZO(a)-PYRENE	INDENO-(1,2,3-cd) PYRENE	BENZO(g,h,i) PERYLENE	LIPIDS (%)
1 90NF02ZM0082	24.2	34.1	41.4			30.4	L30	L30	32.0
2 90NF02ZM0003	L15	L15	L15	L30	L30	L30	L30	L30	23.0
3 90NF02ZM0003	L15	L15	L15	L30	L30	L30	L30	L30	9.2
4 90NF02ZM0089	L15	L15	L15	L30	L30	L30	L30	L30	2.4
5 90NF02ZM0109									11.0

STATION	MERCURY TOTAL MG/KG	CADMIUM TOTAL MG/KG	CHROMIUM TOTAL MG/KG	COPPER TOTAL MG/KG	NICKEL TOTAL MG/KG	LEAD TOTAL MG/KG	ZINC TOTAL MG/KG
1 90NF02ZM0082	0.05	L.02	0.77	4.67	0.59	0.33	51.9
2 90NF02ZM0003	0.09	0.02	0.40	2.99	0.08	L.10	58.3
3 90NF02ZM0003	0.08	0.03	0.35	2.92	L.05	L.10	56.4
4 90NF02ZM0089	0.04	0.06	0.36	2.71	0.05	0.47	48.3
5 90NF02ZM0109	0.03	0.03	0.33	2.85	0.06	0.23	43.1

TABLE 9
LONGTERM SURFACE WATER QUALITY DATA FOR THE WATERFORD RIVER
AT KILBRIDE NF02ZM0009 1986 - 1990

STATION	SAMPLE DATE	APPAR COLOUR REL UNIT	SP COND LAB USIE/CM	SP COND FIELD USIE/CM	TEMP FIELD DEG.C.	TURBID JTU	DISS OR CARBON MG/L	DISS NITRO NO3,NO2 MG/L	TOTAL NITRO MG/L
1 00NF02ZM0009	17-OCT-86	5	252.900	244.000	9.200	0.190	2.300	0.230	0.131
2 00NF02ZM0009	28-NOV-86	10	223.000	249.000	2.500	0.730	2.600	0.497	0.511
3 00NF02ZM0009	23-DEC-86	5	335.500	362.000	0.400	0.110	1.800	0.566	0.770
4 00NF02ZM0009	30-JAN-87	10	475.000	436.000	0.100	0.270	1.800	0.546	0.757
5 00NF02ZM0009	27-FEB-87	5	610.000	573.000	0.300	0.310	2.300	0.536	0.702
6 00NF02ZM0009	25-MAR-87	10	699.000	845.000	2.900	0.670	2.700	0.481	0.752
7 00NF02ZM0009	23-APR-87	20	188.300	214.000	8.700	0.470	4.100	0.247	0.326
8 00NF02ZM0009	25-MAY-87	10	331.000	344.000	7.800	0.340	3.600	0.409	0.639
9 00NF02ZM0009	17-JUN-87	10	355.900	347.000	18.500	0.360	3.600	0.323	0.700
10 00NF02ZM0009	17-JUN-87	10	348.000	349.000	18.800	0.800	2.600	0.310	0.380
11 00NF02ZM0009	09-JUL-87	5	362.000	362.000	20.300	0.500	3.000	0.397	0.640
12 00NF02ZM0009	19-AUG-87	5	357.000	357.000	15.600	0.330	1.700	0.471	0.642
13 00NF02ZM0009	21-OCT-87	5	372.000	339.000	9.700	0.500	1.900	0.367	0.479
14 00NF02ZM0009	23-NOV-87	20	264.000	221.000	6.400	0.550	4.300	0.507	0.704
15 00NF02ZM0009	23-DEC-87	10	398.000	460.000	0.800	0.510	2.600	0.753	0.934
16 00NF02ZM0009	18-JAN-88	10	1624.000	1678.000	0.300	1.800	2.200	0.552	0.862
17 00NF02ZM0009	10-FEB-88	5	795.000	815.000	0.700	0.380	2.000	0.481	0.895
18 00NF02ZM0009	17-MAR-88	5	1231.000	1262.000	1.000	1.100	1.900	0.555	0.720
19 00NF02ZM0009	11-APR-88	5	353.000	400.000	3.400	5.700	3.000	0.400	
20 00NF02ZM0009	05-MAY-88	20	283.000	306.000	5.700	1.000	3.500	0.380	0.583
21 00NF02ZM0009	09-JUN-88	5	346.000	384.000	10.100	0.430	3.400	0.310	0.461
22 00NF02ZM0009	05-JUL-88	10	342.000	365.000	17.800	0.320	4.900	0.420	0.644
23 00NF02ZM0009	11-AUG-88	10	356.000	361.000	18.700	0.150	3.400	0.400	
24 00NF02ZM0009	20-SEP-88	10	354.000	74.000	11.800	0.150	2.500	0.570	0.626
25 00NF02ZM0009	21-OCT-88	5	283.000	301.000	10.200	0.480	3.000	0.710	0.780
26 00NF02ZM0009	16-NOV-88	3.5	247.000	282.000	5.400	2.000	3.500	0.600	0.609
27 00NF02ZM0009	15-DEC-88	5	2066.000	2000.000	0.400	0.500	2.000	0.540	0.829
28 00NF02ZM0009	06-JAN-89	5	918.000	1034.000	0.300	1.500	2.200	0.480	0.633
29 00NF02ZM0009	06-JAN-89	5	974.000	1034.000	0.300	1.000	2.200	0.480	0.656
30 00NF02ZM0009	06-JAN-89	5	972.000	1034.000	0.300	0.500	2.200	0.450	0.757
31 00NF02ZM0009	14-FEB-89	5	12.000	1320.000	0.300	0.550	1.900	0.580	0.796
32 00NF02ZM0009	20-MAR-89	10	1228.000	1360.000	0.500	0.270	2.200	0.540	0.832
33 00NF02ZM0009	20-APR-89	10	464.000	535.000	4.500	0.450	2.800	0.360	0.522
34 00NF02ZM0009	20-APR-89	10	464.000	535.000	4.500	0.500	2.800	0.360	0.474
35 00NF02ZM0009	20-APR-89	10	464.000	535.000	4.500	0.550	2.800	0.360	0.471
36 00NF02ZM0009	23-MAY-89	5	536.000	497.000	17.400	0.700	2.500	0.290	0.431
37 00NF02ZM0009	22-JUN-89	10	495.000	501.000	14.700	0.600	3.300	0.470	0.572
38 00NF02ZM0009	21-JUL-89	5	558.000	571.000	17.400	0.270	3.300	0.600	0.739
39 00NF02ZM0009	14-AUG-89	5	578.000	570.000	16.100	0.130	4.400	0.520	1.014
40 MAXIMUM		20	2066.000	2000.000	20.300	5.700	4.900	0.753	1.014
41 MINIMUM		3.5	12.000	74.000	0.100	0.110	1.700	0.230	0.131
42 MEAN		8.16	551.656	601.436	7.392	0.709	2.790	0.463	0.648
43 MEDIAN		5	372.000	436.000	5.400	0.500	2.600	0.480	0.644
44 COUNT		39	39.000	39.000	39.000	39.000	39.000	39.000	37.000

TABLE 9
LONGTERM SURFACE WATER QUALITY DATA FOR THE WATERFORD RIVER
AT KILBRIDE NF02ZM0009 1986 - 1990

STATION	DISS OXYGEN MG/L	TOTAL ALKALIN MG/L	PH LAB PH UNITS	PH FIELD PH UNITS	DISS SODIUM MG/L	DISS MAGNESIUM MG/L	EXTRBLE ALUMINUM MG/L	SILICA REACTIVE MG/L	TOTAL PHOSPH MG/L
1 00NF02ZM0009	11.300	11.500	7.100	6.370	34.200	2.030	0.100		0.029
2 00NF02ZM0009	13.000	6.400	6.800	6.620	32.800	1.500	0.171		0.028
3 00NF02ZM0009	13.800	7.800	6.900	6.430	48.100	2.100	0.071		0.021
4 00NF02ZM0009	14.000	7.700	6.900	6.900	66.500	2.200	0.078		0.024
5 00NF02ZM0009	14.300	7.700	6.900	6.770	94.600	2.600	0.063		0.023
6 00NF02ZM0009	12.400	5.900	6.800	6.650	110.000	2.300	0.271		0.051
7 00NF02ZM0009	11.500	3.600	6.600	6.470	26.700	1.100	0.181		0.022
8 00NF02ZM0009	12.100	9.500	7.100	6.670	46.700	2.200	0.072		0.018
9 00NF02ZM0009	10.100	10.600	7.900	6.760	49.200	2.400	0.067		0.049
10 00NF02ZM0009	10.100	10.700	7.900	6.600	48.000	2.400	0.072	2.290	0.051
11 00NF02ZM0009	9.500	11.800	7.300	6.580	50.700	2.400	0.099		0.042
12 00NF02ZM0009	9.800	13.800	7.400	7.130	50.100	2.700	0.112	2.960	0.033
13 00NF02ZM0009	12.200	11.200	7.500	6.460	46.600	2.490	0.045	2.120	0.035
14 00NF02ZM0009	11.900	7.100	6.900	6.340	32.200	1.740	0.259	4.600	0.051
15 00NF02ZM0009	14.100	8.200	6.900	6.490	60.500	2.070	0.103	4.920	0.029
16 00NF02ZM0009	13.800	11.200	6.800	6.500	282.000	2.940	0.148	5.020	0.043
17 00NF02ZM0009	14.000	8.600	6.800	6.650	121.000	3.400	0.067	5.030	0.032
18 00NF02ZM0009	14.200	5.500	6.800	6.730	217.000	2.540	0.095	3.820	0.022
19 00NF02ZM0009	12.800	5.600	6.800	6.380	52.100	1.940	1.050	2.820	0.286
20 00NF02ZM0009	11.900	4.500	6.800	6.700	45.400	1.490	0.186	2.660	0.041
21 00NF02ZM0009	11.700	8.600	7.200	6.800	54.700	2.100	0.136	2.110	0.041
22 00NF02ZM0009		11.100	7.200	6.770	55.400	2.290	0.132	4.200	0.054
23 00NF02ZM0009	9.400	13.800	7.400	6.470	50.900	2.500	0.090	4.460	0.039
24 00NF02ZM0009	11.400	12.600	7.500	6.650	56.600	2.200	0.055	2.850	0.041
25 00NF02ZM0009	11.300	12.100	7.300	6.280	46.100	2.170	0.189	4.240	0.046
26 00NF02ZM0009	12.800	9.900	7.000	6.650	34.400	1.820	0.214	5.060	0.050
27 00NF02ZM0009		8.300	6.800	6.410	383.000	2.310	0.650	3.270	0.056
28 00NF02ZM0009	14.600	6.200	6.900	6.750	165.000	3.100	0.091	4.570	0.032
29 00NF02ZM0009	14.600	6.200	6.900	6.730	167.000	3.200	0.091	4.440	0.027
30 00NF02ZM0009	14.600	6.000	6.900	6.780	167.000	3.200	0.090	4.510	0.027
31 00NF02ZM0009	14.100	9.900	6.900	6.220	207.000	3.100	0.067	5.490	0.025
32 00NF02ZM0009	14.100	6.400	6.800	6.400	204.000	3.490	0.089	4.640	0.028
33 00NF02ZM0009	13.000	4.700	6.800	6.590	73.200	2.400	0.078	3.340	0.028
34 00NF02ZM0009	13.000	4.800	6.800	6.640	73.200	2.390	0.078	3.350	0.027
35 00NF02ZM0009	13.000	4.900	6.800	6.630	73.200	2.400	0.080	3.340	0.034
36 00NF02ZM0009	10.600	8.900	7.700	6.870	82.400	3.360	0.045	0.770	0.034
37 00NF02ZM0009	9.800	8.600	7.100	7.170	75.900	2.820	0.067	3.960	0.044
38 00NF02ZM0009	9.200	12.400	7.400	8.120	83.000	3.300	0.040	4.390	0.046
39 00NF02ZM0009	9.400	14.000	7.600	7.380	83.600	3.700	0.028	4.440	0.042
40 MAXIMUM	14.600	14.000	7.900	8.120	383.000	3.700	1.050	5.490	0.286
41 MINIMUM	9.200	3.600	6.600	6.220	26.700	1.100	0.028	0.770	0.018
42 MEAN	12.254	8.674			93.590	2.472	0.144	3.782	0.042
43 MEDIAN	12.400	8.600			60.500	2.400	0.090	4.200	0.034
44 COUNT	37.000	39.000	39.000	39.000	39.000	39.000	39.000	29.000	39.000

TABLE 9
LONGTERM SURFACE WATER QUALITY DATA FOR THE WATERFORD RIVER
AT KILBRIDE NF02ZM0009 1986 - 1990

STATION	DISS SULPHATE MG/L	DISS SULPHATE IC-MG/L	DISS CHLORIDE MG/L	DISS POTASS MG/L	DISS CALCIUM MG/L	EXTRBLE MANGANE MG/L	EXTRBLE IRON MG/L	TOTAL COBALT MG/L	TOTAL NICKEL MG/L
1 00NF02ZM0009	9.000	8.680	58.150	1.240	9.310	0.154	0.293	0.0008	L.0002
2 00NF02ZM0009	9.800	8.000	53.400	0.950	6.410	0.125	0.210	0.0003	0.0004
3 00NF02ZM0009	4.400	9.520	85.600	1.040	9.160	0.282	0.182	0.0006	0.0003
4 00NF02ZM0009	9.800	11.700	121.000	1.090	10.300	0.279	0.161	0.0010	0.0015
5 00NF02ZM0009	10.200	10.100	159.000	1.300	12.500	0.399	0.196	0.0009	0.0005
6 00NF02ZM0009	10.600	10.600	181.000	1.520	11.900	0.371	0.400	0.0013	L.0002
7 00NF02ZM0009	6.900	5.270	45.400	0.770	4.500	0.129	0.237	0.0005	0.0007
8 00NF02ZM0009	7.900	7.920	82.900	1.040	9.600	0.183	0.243	0.0004	L.0002
9 00NF02ZM0009	7.700	8.000	87.800	1.150	11.400	0.116	0.197	0.0003	L.0002
10 00NF02ZM0009		6.400	91.000	1.000	11.000	0.110	0.210		L.0002
11 00NF02ZM0009	9.500	8.940	91.700	1.170	11.300	0.217	0.271	0.0005	L.0002
12 00NF02ZM0009	8.800	8.550	87.600	1.160	12.700	0.113	0.253	0.0003	0.0003
13 00NF02ZM0009	9.700	9.360	81.700	1.130	12.100	0.111	0.145	0.0005	0.0003
14 00NF02ZM0009	11.100	10.700	49.300	1.230	6.830	0.160	0.426	0.0006	0.0008
15 00NF02ZM0009	12.000	10.400	96.300	1.190	9.490	0.235	0.220	0.0006	0.0006
16 00NF02ZM0009	24.600	34.100	453.000	2.320	21.500	0.373	0.406	0.0010	0.0007
17 00NF02ZM0009	13.800	16.200	206.000	1.430	16.000	0.429	0.188	0.0010	0.0009
18 00NF02ZM0009	15.900	17.100	353.000	1.460	14.500	0.260	0.167	0.0006	0.0004
19 00NF02ZM0009	10.600	10.800	89.400	1.390	9.130	0.249	1.750	0.0011	0.0009
20 00NF02ZM0009	9.300	8.630	69.000	0.970	6.220	0.119	0.215	0.0004	0.0003
21 00NF02ZM0009	9.000	9.750	86.900	0.960	9.520	0.133	0.242	0.0004	0.0004
22 00NF02ZM0009	9.500	9.870	85.500	0.910	10.100	0.213	0.496	0.0005	L.0002
23 00NF02ZM0009	7.500	8.470	89.100	1.250	11.300	0.088	0.361	0.0003	L.0002
24 00NF02ZM0009	9.500	9.950	91.000	1.200	10.800	0.093	0.174	0.0003	0.0004
25 00NF02ZM0009	10.400	11.600	67.200	1.560	9.850	0.131	0.419	0.0004	0.0006
26 00NF02ZM0009	9.700	10.000	57.700	1.440	7.570	0.151	0.412	0.0005	0.0005
27 00NF02ZM0009	34.800	40.100	615.000	2.470	23.300	0.361	1.320	0.0012	0.0012
28 00NF02ZM0009	16.100	16.400	269.000	3.340	15.000	0.296	0.154	0.0006	0.0005
29 00NF02ZM0009	15.500	15.300	276.000	3.350	14.900	0.299	0.159	0.0006	0.0006
30 00NF02ZM0009	16.000	15.500	275.000	3.340	14.900	0.297	0.153	0.0007	0.0006
31 00NF02ZM0009	19.900	19.800	340.000	3.070	18.800	0.444	0.204	0.0011	0.0005
32 00NF02ZM0009	14.700	16.300	354.000	2.780	18.100	0.376	0.177	0.0009	0.0004
33 00NF02ZM0009	9.100	9.460	125.000	1.370	10.600	0.200	0.143	0.0006	0.0003
34 00NF02ZM0009	9.400	9.520	127.000	1.370	10.700	0.212	0.148	0.0005	0.0002
35 00NF02ZM0009	9.400	9.510	125.000	1.360	10.600	0.209	0.152	0.0005	0.0004
36 00NF02ZM0009	10.100	9.420	147.000	1.540	15.300	0.144	0.170	0.0004	0.0002
37 00NF02ZM0009	9.600	10.100	133.000	1.340	13.660	0.219	0.263	0.0003	L.0002
38 00NF02ZM0009	9.950	10.400	149.000	1.760	16.100	0.166	0.246	0.0003	L.0002
39 00NF02ZM0009	10.000	9.140	150.000	2.030	16.900	0.097	0.151	0.0003	L.0002
40 MAXIMUM	34.800	40.100	615.000	3.350	23.300	0.444	1.750	0.0013	0.0015
41 MINIMUM	4.400	5.270	45.400	0.770	4.500	0.088	0.143	0.0003	L.0002
42 MEAN	11.625	12.091	156.529	1.564	12.150	0.219	0.305	0.0006	
43 MEDIAN	9.800	9.950	96.300	1.340	11.300	0.209	0.210	0.0005	
44 COUNT	38.000	39.000	39.000	39.000	39.000	39.000	39.000	38.0000	38.0000

TABLE 9
LONGTERM SURFACE WATER QUALITY DATA FOR THE WATERFORD RIVER
AT KILBRIDE NF02ZM0009 1986 - 1990

STATION	EXTRBLE COPPER MG/L	EXTRBLE ZINC MG/L	EXTRBLE CADMIUM MG/L	EXTRBLE MERCURY UG/L	EXTRBLE LEAD MG/L
1 00NF02ZM0009	0.0014	0.0175	L.0001	L.02	0.0011
2 00NF02ZM0009	0.0016	0.0271	L.0001	L.02	0.0008
3 00NF02ZM0009	0.0045	0.0336	L.0001	L.02	0.0003
4 00NF02ZM0009	0.0023	0.0363	0.0003	L.02	0.0033
5 00NF02ZM0009	0.0016	0.0415	0.0001	L.02	0.0012
6 00NF02ZM0009	0.0032	0.0564	0.0002	L.02	0.0036
7 00NF02ZM0009	0.0016	0.0172	L.0001	L.02	0.0005
8 00NF02ZM0009	0.0031	0.0208	L.0001	L.02	L.0002
9 00NF02ZM0009	0.0029	0.0126	L.0001	L.02	0.0009
10 00NF02ZM0009	0.0200	0.0100	L.0001	L.02	0.0011
11 00NF02ZM0009	0.0057	0.0161	L.0001	L.02	L.0002
12 00NF02ZM0009	0.0060	0.0190	L.0001	L.02	0.0020
13 00NF02ZM0009	0.0025	0.0097	L.0001	L.02	0.0009
14 00NF02ZM0009	0.0027	0.0301	0.0001	0.010	0.0024
15 00NF02ZM0009	0.0027	0.0342	0.0001	L.01	0.0018
16 00NF02ZM0009	0.0127	0.0827	0.0006	L.01	0.0071
17 00NF02ZM0009	0.0060	0.0538	0.0003	0.010	0.0030
18 00NF02ZM0009	0.0030	0.0542	0.0002	L.01	0.0002
19 00NF02ZM0009	0.0094	0.0650	0.0004	L.01	0.0142
20 00NF02ZM0009	0.0024	0.0252	L.0001	L.01	0.0003
21 00NF02ZM0009	0.0023	0.0154	L.0001	L.01	0.0005
22 00NF02ZM0009	0.0030	0.0217	L.0001	0.060	0.0012
23 00NF02ZM0009	0.0025	0.0108	L.0001	L.01	0.0007
24 00NF02ZM0009	0.0015	L.01	L.0001	L.01	0.0006
25 00NF02ZM0009	0.0028	0.0273	0.0001	L.01	0.0018
26 00NF02ZM0009	0.0027	0.0272	0.0001	L.01	0.0023
27 00NF02ZM0009	0.0096	0.1240	0.0008	0.030	0.0168
28 00NF02ZM0009	0.0016	0.0602	0.0003	L.01	0.0015
29 00NF02ZM0009	0.0016	0.0621	0.0002	L.01	0.0003
30 00NF02ZM0009	0.0016	0.0618	0.0002	L.01	0.0011
31 00NF02ZM0009	0.0024	0.0533	0.0003	0.010	L.0002
32 00NF02ZM0009	0.0024	0.0632	0.0002	0.020	0.0012
33 00NF02ZM0009	0.0015	0.0257	0.0001	0.020	0.0004
34 00NF02ZM0009	0.0015	0.0266	0.0001	0.010	L.0002
35 00NF02ZM0009	0.0019	0.0269	0.0002	0.010	L.0002
36 00NF02ZM0009	0.0020	0.0170	L.0001	L.01	0.0017
37 00NF02ZM0009	0.0021	0.0250	L.0001	0.010	.
38 00NF02ZM0009	0.0018	0.0207	L.0001	L.01	0.0003
39 00NF02ZM0009	0.0023	0.0141	L.0001	0.010	L.0002
40 MAXIMUM	0.0200	0.1240	0.0010	0.060	0.0168
41 MINIMUM	L.002	L.01	L.0001	L.01	L.0002
42 MEAN	0.0037	0.0347	0.0002	0.016	0.0023
43 MEDIAN	0.0024	0.0269	0.0001	0.010	0.0011
44 COUNT	39.0000	39.0000	39.0000	43.000	43.0000

TABLE 10

LIST OF STATIONS SAMPLED DURING THE 1990

QUIDI VIDI BASIN RECURRENT SURVEY

STATION #		DESCRIPTION
1.	00NF02ZM0042	Lat. 47°34'16" Long. 52°47'42" Leary's Brook, approx. 1 km upstream of confluence with Carty's Stream, midstream
2.	00NF02ZM0046	Lat. 47°33'21" Long. 52°46'36" Yellow Marsh Stream approx. 500 m. upstream of Pippy Place, midstream
3.	00NF02ZM0123	Lat. 47°33'27" Long. 52°46'39" Unnamed tributary flowing along Kenmount Road, 5 m upstream of confluence with Yellow Marsh Stream, St. John's
4.	00NF02ZM0124	Lat. 47°33'39" Long. 52°45'42" Leary's Brook at O'Leary Avenue, 3 m below unidentified outfall, St. John's
5.	00NF02ZM0125	Lat. 47°33'47" Long. 52°45'55" Leary's Brook 5 m above confluence with Yellow Marsh Stream, St. John's
6.	00NF02ZM0126	Lat. 47°33'40" Long. 52°45'58" Yellow Marsh Stream 5 m above confluence with Leary's Brook, St. John's
7.	00NF02ZM0127	Lat. 47°34'05" Long. 52°46'40" Leary's Brook 100 m upstream of Thorburn Road, St. John's
8.	00NF02ZM0128	Lat. 47°34'20" Long. 52°46'33" Carty's Stream, 50 m upstream of Groves Road, St. John's

STATION #		DESCRIPTION
9.	00NF02ZM0129	Lat. 47°34'05" Long. 52°46'07" Unnamed tributary, 0.5 km downstream of Oxen Pond at Groves Road, St. John's
10.	00NF02ZM0130	Lat. 47°33'44" Long. 52°45'00" Leary's Brook 100 m downstream of Thorburn Road, below Avalon Mall, St. John's
11.	00NF02ZM0070	Lat. 47°35'03" Long. 52°45'18" Nagles Hill Brook at western end of Nagles Hill Road, approx. 0.5 km downstream of Left Pond, midstream, St. John's
12.	00NF02ZM0131	Lat. 47°34'53" Long. 52°44'13" Nagles Hill Brook at headquarters of Pippy Park, 0.5 km upstream of Long Pond, St. John's
13.	00NF02ZM0132	Lat. 47°34'48" Long 52°43'47" Unnamed tributary below Kents Pond, 10 m above confluence with Rennies River, St. John's
14.	00NF02ZM0133	Lat. 47°34'44" Long. 52°43'45" Rennies River, 50 m downstream Long Pond outlet, St. John's
15.	01NF02ZM0134	Lat. 47°34'42" Long. 52°44'12" Long Pond 100 m downstream inlet of Leary's Brook, St. John's
16.	01NF02ZM0135	Lat. 47°35'23" Long. 52°43'31" Kents Pond 10 m above pond's outlet, St. John's
17.	00NF02ZM0016	Lat. 47°34'40" Long. 52°42'03" Rennies River at bridge on Carnell Drive near outlet into Quidi Vidi Lake, St. John's
18.	01NF02ZM0136	Lat. 47°34'12" Long. 52°46'50" Pond on Leary's Brook, 200 m downstream Juniper Pond, close to pond outlet, St. John's

STATION #		DESCRIPTION
19.	01NF02ZM0137	Lat. 47°34'18" Long. 52°45'57" Oxen Pond 10 m above pond's outlet, St. John's
20.	00NF02ZM0138	Lat. 47°34'25" Long. 52°44'26" Leary's Brook 100 m above bend in stream at MUN, 0.7 km above Long Pond, midstream, St. John's
21.	01NF02ZM0139	Lat. 47°34'50" Long. 52°43'58" Long Pond, 10 m below Nagles Hill Brook inlet to pond, St. John's
22.	01NF02ZM0140	Lat. 47°36'18" Long. 52°42'27" Virginia Lake 20 m below Virginia River inlet to lake, St. John's
23.	00NF02ZM0141	Lat. 47°36'12" Long. 52°42'30" Virginia River 100 m above outflow into Virginia Lake, midstream, St. John's
24.	00NF02ZM0142	Lat. 47°36'15" Long. 52°42'19" Virginia River 50 m below Virginia Lake, midstream, St. John's
25.	00NF02ZM0143	Lat. 47°36'10" Long. 52°43'05" Virginia River at Torbay Road, St. John's
26.	00NF02ZM0098	Lat. 47°35'54" Long. 52°45'30" Virginia River approx. 1.2 km upstream of McNiven Place, midstream, St. John's
27.	00NF02ZM0144	Lat. 47°34'28" Long. 52°42'45" Kellys Brook at confluence with Rennies River, Rennies Mill Road, St. John's
28.	00NF02ZM0015	Lat. 47°35'02" Long. 52°40'51" Quidi Vidi Lake outlet from the Boulevard Bridge, St. John's
29.	00NF02ZM0014	Lat. 47°35'02" Long. 52°41'29" Virginia River 30 m upstream of the Boulevard Bridge near outlet into Quidi Vidi Lake, St. John's

STATION #		DESCRIPTION
30.	00NF02ZM0145	Lat. 47°34'40" Long. 52°42'15" Pipe outfall at confluence with Rennies River, 100 m upstream of Quidi Vidi Lake, St. John's
31.	00NF02ZM0146	Lat. 47°36'05" Long. 52°42'20" Unnamed culverted tributary just above confluence with Virginia River, 100 m upstream of Fagan Drive, St. John's
32.	00NF02ZM0147	Lat. 47°35'53" Long. 52°42'10" Unnamed culverted tributary just above confluence with Virginia River, 100 m above Logy Bay Road, St. John's
33.	00NF02ZM0148	Lat. 47°35'45" Long. 52°41'51" Virginia River 100 m below Logy Bay Road, St. John's
34.	00NF02ZM0149	Lat. 47°35'03" Long. 52°41'22" Virginia River at Boulevard Bridge near inflow into Quidi Vidi Lake, St. John's

TABLE 11
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES,
MAJOR IONS, METALS AND NUTRIENTS

STATION	SAMPLE NUMBER	SAMPLE DATE	SAMPLE TIME	PH FIELD PH UNITS	DIS O2 MG/L	SP COND FIELD USIE/CM	TEMP FIELD DEG.C.	PH LAB PH UNITS	SP COND LAB USIE/CM	TURB JTU
1 LEARYS BROOK										
2 00NF02ZM0042	1868	07-AUG-90	1140	6.2	9.37	54.7	16.70	6.10	52	0.60
3 00NF02ZM0128	1877	08-AUG-90	1145	6.7	9.03	55.8	18.60	6.50	51	0.80
4 00NF02ZM0127	1876	08-AUG-90	1035	6.6	8.14	81.9	20.50	6.50	78	0.90
5 00NF02ZM0129	1878	08-AUG-90	1201	6.4	8.42	53.7	18.60	6.30	52	0.50
6 00NF02ZM0125	1874	07-AUG-90	1630	6.9	8.52	139.9	20.50	6.70	136	0.70
7 TRIBUTARY YELLOW MARSH S										
8 00NF02ZM0046	1869	07-AUG-90	1400	6.5	9.30	41.3	17.50	6.20	40	0.60
9 00NF02ZM0123	1870	07-AUG-90	1201	6.5	9.33	462.0	16.50	6.20	430	0.80
10 00NF02ZM0126	1875	07-AUG-90	1645	6.4	9.14	381.0	16.00	6.40	368	0.70
11 LEARYS BROOK										
12 00NF02ZM0124	1871	07-AUG-90	1530	6.8	9.10	197.7	18.30	6.60	290	0.80
13 00NF02ZM0124	1872	07-AUG-90	1535	6.8	9.10	197.7	18.30	6.50	290	0.70
14 00NF02ZM0124	1873	07-AUG-90	1540	6.8	9.10	197.7	18.30	6.60	290	0.80
15 00NF02ZM0130	1879	08-AUG-90	1330	6.7	8.80	193.0	19.60	6.50	320	0.70
16 00NF02ZM0138	1886	13-AUG-90	1045	6.8				6.50	480	0.90
17 TRIBUTARY NAGLES BROOK										
18 00NF02ZM0070	1880	08-AUG-90	1445	6.3	8.28	39.6	18.90	6.20	40	0.60
19 00NF02ZM0131	1881	08-AUG-90	1515	6.9	9.46	105.2	17.12	6.70	99	0.30
20 00NF02ZM0131	1882	08-AUG-90	1520	6.9	9.46	105.2	17.10	6.70	100	0.30
21 00NF02ZM0131	1883	08-AUG-90	1525	6.9	9.46	105.2	17.10	6.60	99	0.30
22 LONG POND RENNIES RIVER										
23 00NF02ZM0133	1885	08-AUG-90	1700	6.8	8.26	423.0	21.60	6.70	422	0.50
24 TRIBUTARY KENTS POND										
25 00NF02ZM0132	1884	08-AUG-90	1645	6.9	8.02	1005.0	22.00	6.90	1000	0.80
26 TRIBUTARY-KELLY BROOK										
27 00NF02ZM0144	1891	14-AUG-90	930	7.2	8.80	565.0	19.90	6.70	530	1.30
28 RENNIES RIVER CANAL PARK										
29 00NF02ZM0145	1892	14-AUG-90	1215	7.0	8.60	770.0	19.60	6.60	820	0.70
30 VIRGINIA RIVER										
31 00NF02ZM0098	1890	13-AUG-90	1645	6.3	7.64	51.9	25.30	6.30	50	1.10
32 00NF02ZM0143	1889	13-AUG-90	1630	7.2	8.18	244.0	20.90	7.00	237	0.40
33 00NF02ZM0141	1887	13-AUG-90	1430	7.1	9.22	522.0	19.50	6.90	500	0.90
34 00NF02ZM0142	1888	13-AUG-90	1445	7.3	7.73	387.0	26.90	6.90	380	0.70
35 00NF02ZM0146	1893	14-AUG-90	1430	6.1	10.10	765.0	10.60	6.40	690	2.00
36 00NF02ZM0148	1897	14-AUG-90	1530	7.0	9.82	662.0	20.80	6.90	635	0.80
37 00NF02ZM0147	1894	14-AUG-90	1500	6.7	10.50	1066.0	13.70	6.80	1020	0.60
38 00NF02ZM0147	1895	14-AUG-90	1505	6.7	10.50	1066.0	13.70	6.80	1040	0.50
39 00NF02ZM0147	1896	14-AUG-90	1510	6.7	10.50	1066.0	13.70	6.70	970	0.70
40 00NF02ZM0014	5364	14-AUG-90	1120	8.3	10.10	812.0	18.50	6.99	812	0.39
41 QUIDI VIDI OUTLET										
42 00NF02ZM0015	5363	14-AUG-90	1045	7.5	8.60	522.0	22.40	6.81	533	0.81

TABLE 11
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES,
MAJOR IONS, METALS AND NUTRIENTS

STATION	TOTAL ALKALIN MG/L	APPARENT COLOUR REL UNITS	DISS CALCIUM MG/L	DISS MAGNES MG/L	DISS POTASS MG/L	DISS SODIUM MG/L	DISS CHLORIDE MG/L	DISS SULPHATE MTB MG/L	DISS SULPHATE MG/L	SILICA (MB) MG/L
1 LEARYS BROOK										
2 00NF02ZM0042	2.5	70	1.10	0.72	0.23	7.2	13.4	1.95	1.5	4.50
3 00NF02ZM0128	3.8	10	1.60	0.83	0.28	6.6	10.9	2.76	2.7	4.80
4 00NF02ZM0127	3.8	30	1.90	0.91	0.23	11.7	20.6	1.46	1.6	3.80
5 00NF02ZM0129	2.6	L5.	1.60	0.63	0.37	6.7	9.0	3.70	3.6	1.20
6 00NF02ZM0125	5.0	20	3.10	1.00	0.54	20.0	35.0	3.49	3.3	3.70
7 TRIBUTARY YELLOW MARSH S										
8 00NF02ZM0046	1.9	10	0.78	0.54	0.25	5.6	8.8	2.28	2.6	4.30
9 00NF02ZM0123	2.4	20	4.60	1.40	1.20	78.0	125.0	5.61	5.7	4.70
10 00NF02ZM0126	3.7	L5.	6.10	1.60	1.10	62.0	105.0	7.31	7.4	5.00
11 LEARYS BROOK										
12 00NF02ZM0124	4.2	L5.	5.30	1.40	0.93	49.0	80.0	5.64	5.9	4.50
13 00NF02ZM0124	4.1	5	5.00	1.40	0.93	49.0	80.0	5.75	5.9	4.40
14 00NF02ZM0124	4.0	5	5.00	1.40	0.93	48.0	80.0	5.75	5.8	4.50
15 00NF02ZM0130	5.6	L5.	6.60	1.40	1.00	49.0	80.0	6.50	6.5	3.50
16 00NF02ZM0138	6.2	L5.	10.00	1.90	1.40	78.0	130.0	9.22	9.2	3.40
17 TRIBUTARY NAGLES BROOK										
18 00NF02ZM0070	3.0	L5.	1.20	0.57	0.23	5.4	7.0	2.24	2.2	3.10
19 00NF02ZM0131	4.5	L5.	4.10	1.10	0.67	12.4	19.8	3.82	3.8	4.20
20 00NF02ZM0131	4.6	L5.	4.10	1.30	0.64	12.5	19.0	3.97	3.8	4.20
21 00NF02ZM0131	4.7	L5.	4.10	1.30	0.64	12.3	19.6	3.88	3.9	4.10
22 LONG POND RENNIES RIVER										
23 00NF02ZM0133	7.7	L5.	8.50	1.70	1.20	68.0	115.0	8.04	7.8	1.80
24 TRIBUTARY KENTS POND										
25 00NF02ZM0132	18.1	10	22.00	4.90	2.10	161.0	300.0	8.58	8.4	4.00
26 TRIBUTARY-KELLY BROOK										
27 00NF02ZM0144	10.3	5	14.00	2.30	1.60	86.0	150.0	8.88	8.7	2.40
28 RENNIES RIVER CANAL PARK										
29 00NF02ZM0145	11.9	L5.	27.00	4.00	2.40	139.0	205.0	15.65	15.3	4.50
30 VIRGINIA RIVER										
31 00NF02ZM0098	3.7	40	1.70	0.86	0.25	6.2	7.9	3.76	2.4	3.90
32 00NF02ZM0143	10.7	L5.	6.50	2.20	1.10	35.6	62.0	4.40	4.2	5.60
33 00NF02ZM0141	14.6	L5.	18.00	3.70	1.60	72.0	135.0	14.75	14.5	6.40
34 00NF02ZM0142	10.9	L5.	11.00	2.70	1.40	56.0	84.0	9.93	9.8	0.88
35 00NF02ZM0146	10.1	L5.	18.00	4.60	2.00	111.0	190.0	20.68	21.0	8.60
36 00NF02ZM0148	12.2	L5.	18.00	4.20	2.00	98.0	175.0	16.33	16.5	4.30
37 00NF02ZM0147	16.8	L5.	30.00	6.30	2.70	146.0	250.0	21.95	22.0	7.40
38 00NF02ZM0147	16.9	L5.	29.00	6.30	2.70	155.0	250.0	22.13	22.0	7.40
39 00NF02ZM0147	17.0	5	30.00	6.30	2.70	146.0	250.0	21.83	22.0	6.40
40 00NF02ZM0014	18.4	L5.0	21.20	5.08	2.06	121.0	220.0	15.50	14.8	4.94
41 QUIDI VIDI OUTLET										
42 00NF02ZM0015	10.4	10	12.50	2.52	1.43	80.5	146.0	9.50	11.2	0.25

TABLE 11

QUIDI VIDI BASIN RECURRENT SURVEY 1990

SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES, MAJOR IONS, METALS AND NUTRIENTS

STATION	TOTAL PHOSPH MG/L	DISS NITRO NO3,NO2 MG/L	TOTAL NITRO MG/L	DISS ORG CARBON MG/L	EXTRBLE ALUMINUM MG/L	EXTRBLE IRON MG/L	EXTRBLE MANGANESE MG/L	EXTRBLE COPPER MG/L	EXTRBLE ZINC MG/L
1 LEARYS BROOK									
2 00NF02ZM0042	0.0070	L.01	0.18	6.0	0.150	1.300	0.7500	L.002	L.01
3 00NF02ZM0128	0.0040	L.01	0.09	2.3	0.093	0.880	0.4500	L.002	L.01
4 00NF02ZM0127	0.0070	L.01	0.15	3.8	0.083	1.300	0.3700	L.002	L.01
5 00NF02ZM0129	0.0170	0.10	0.20	2.0	0.180	0.740	0.5300	L.002	L.01
6 00NF02ZM0125	0.0130	0.29	0.38	2.9	0.058	0.830	0.2200	L.002	0.01
7 TRIBUTARY YELLOW MARSH S									
8 00NF02ZM0046	0.0030	L.01	0.09	2.5	0.080	0.510	0.0400	L.002	L.01
9 00NF02ZM0123	0.2700	0.59	0.64	1.0	0.087	0.490	0.4000	0.003	0.05
10 00NF02ZM0126	0.0290	0.40	0.46	2.1	0.045	0.210	0.3400	0.002	0.05
11 LEARYS BROOK									
12 00NF02ZM0124	0.0200	0.32	0.39	2.2	0.052	0.390	0.2300	0.002	0.03
13 00NF02ZM0124	0.0220	0.30	0.38	2.2	0.045	0.370	0.1800	0.002	0.03
14 00NF02ZM0124	0.0200	0.31	0.40	2.1	0.046	0.380	0.2000	0.002	0.03
15 00NF02ZM0130	0.0300	0.31	0.41	1.9	0.045	0.340	0.1600	0.003	0.02
16 00NF02ZM0138	0.0210	0.56	0.62	2.2	0.040	0.720	0.5000	0.002	0.02
17 TRIBUTARY NAGLES BROOK									
18 00NF02ZM0070	0.0050	L.01	0.10	7.6	0.094	0.760	0.1600	L.002	L.01
19 00NF02ZM0131	0.0080	2.00	2.10	2.5	0.030		0.0100	0.002	L.01
20 00NF02ZM0131	0.0070	2.00	1.60	L.5	0.027		0.0100	0.002	L.01
21 00NF02ZM0131	0.0070	2.00	1.40	L.5	0.026	0.050	0.0100	0.002	L.01
22 LONG POND RENNIES RIVER									
23 00NF02ZM0133	0.0090	0.26	0.40	2.2	0.028	0.420	0.6600	L.002	0.02
24 TRIBUTARY KENTS POND									
25 00NF02ZM0132	0.0040	0.07	0.18	L.5	0.020	0.470	0.7100	L.002	0.02
26 TRIBUTARY-KELLY BROOK									
27 00NF02ZM0144	0.0130	0.90	0.98	1.9	0.033	0.650	0.3200	L.002	0.01
28 RENNIES RIVER CANAL PARK									
29 00NF02ZM0145	0.0700	1.90	1.50	1.4	0.042	0.590	0.5100	0.003	0.02
30 VIRGINIA RIVER									
31 00NF02ZM0098	0.0050	L.01	0.16	4.7	0.140	1.200	0.4600	L.002	L.01
32 00NF02ZM0143	0.0060	0.17	0.29	3.7	0.025	0.140	0.0200	L.002	L.01
33 00NF02ZM0141	0.0100	0.95	0.98	3.0	0.061	0.260	0.1800	0.002	0.09
34 00NF02ZM0142	0.0190	0.19	0.38	3.7	0.039	0.110	0.1800	0.002	L.01
35 00NF02ZM0146	0.0180	1.10	1.60	1.1	0.120	1.000	0.6400	L.002	0.1
36 00NF02ZM0148	0.0280	1.10	1.10	2.3	0.030	0.100	0.1300	0.002	0.03
37 00NF02ZM0147	0.0500	2.60	3.40	1.3	0.046	0.100	0.2300	0.005	0.11
38 00NF02ZM0147	0.0550	2.60	2.20	1.1	0.050	0.100	0.2200	0.006	0.11
39 00NF02ZM0147	0.0500	2.40	2.00	1.2	0.046	0.090	0.2300	0.006	0.12
40 00NF02ZM0014	0.0218	1.04	1.50	3.0	0.040	0.046	0.0227	0.0018	0.0061
41 QUIDI VIDI OUTLET									
42 00NF02ZM0015	0.0069	0.39	0.28	2.9	0.041	0.170	0.0942	0.0019	0.0077

TABLE 11
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES,
MAJOR IONS, METALS AND NUTRIENTS

STATION	EXTRBLE CADIUM MG/L	EXTRBLE LEAD MG/L	TOTAL ARSENIC MG/L	EXTRBLE MERCURY MG/L
1 LEARYS BROOK				
2 00NF02ZM0042	L.001	L.002	L.0005	L.02
3 00NF02ZM0128	L.001	L.002	0.0005	L.02
4 00NF02ZM0127	L.001	L.002	L.0005	L.02
5 00NF02ZM0129	L.001	L.002	L.0005	L.02
6 00NF02ZM0125	L.001	L.002	L.0005	L.02
7 TRIBUTARY YELLOW MARSH S				
8 00NF02ZM0046	L.001	L.002	L.0005	L.02
9 00NF02ZM0123	L.001	L.002	L.0005	L.02
10 00NF02ZM0126	L.001	L.002	L.0005	L.02
11 LEARYS BROOK				
12 00NF02ZM0124	L.001	L.002	L.0005	L.02
13 00NF02ZM0124	L.001	L.002	L.0005	L.02
14 00NF02ZM0124	L.001	L.002	L.0005	L.02
15 00NF02ZM0130	L.001	L.002	L.0005	L.02
16 00NF02ZM0138	L.001	L.002	L.0005	L.02
17 TRIBUTARY NAGLES BROOK				
18 00NF02ZM0070	L.001	L.002	L.0005	L.02
19 00NF02ZM0131	L.001	L.002	L.0005	L.02
20 00NF02ZM0131	L.001	L.002	L.0005	L.02
21 00NF02ZM0131	L.001	L.002	L.0005	L.02
22 LONG POND RENNIES RIVER				
23 00NF02ZM0133	L.001	L.002	L.0005	L.02
24 TRIBUTARY KENTS POND				
25 00NF02ZM0132	L.001	L.002	L.0005	L.02
26 TRIBUTARY-KELLY BROOK				
27 00NF02ZM0144	L.001	L.002	L.0005	L.02
28 RENNIES RIVER CANAL PARK				
29 00NF02ZM0145	L.001	L.002	L.0005	L.02
30 VIRGINIA RIVER				
31 00NF02ZM0098	L.001	L.002	L.0005	L.02
32 00NF02ZM0143	L.001	L.002	L.0005	L.02
33 00NF02ZM0141	L.001	L.002	L.0005	L.02
34 00NF02ZM0142	L.001	L.002	L.0005	L.02
35 00NF02ZM0146	L.001	L.002	L.0005	L.02
36 00NF02ZM0148	L.001	L.002	L.0005	L.02
37 00NF02ZM0147	L.001	L.002	L.0005	L.02
38 00NF02ZM0147	L.001	L.002	L.0005	L.02
39 00NF02ZM0147	L.001	L.002	L.0005	L.02
40 00NF02ZM0014	0.0001	L.0002	0.0001	0.01
41 QUIDI VIDI OUTLET				
42 00NF02ZM0015	L.0001	L.0002	L.0001	0.02

TABLE 12
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES,
MAJOR IONS, METALS AND NUTRIENTS AT SHORT-TERM
PRESURVEY HEADWATER SITES

STATION	SAMPLE NUMBER	SAMPLE DATE	SAMPLE TIME	PH FIELD PH UNITS	DIS O2 MG/L	SP COND FIELD USIE/CM	TEMP FIELD DEG.C.	PH LAB PH UNITS	SP COND LAB USIE/CM	TURB JTU
1 LEARYS BROOK										
2 00NF02ZM0042	308	26-APR-90	1201	4.9	12.70	52.0	2.8	4.9	54.6	0.4
3 00NF02ZM0042	496	24-MAY-90	1201	4.9	12.70		3.0	5.1	41.3	0.2
4 00NF02NF0042	964	22-JUN-90	1130	5.0	10.30		11.1	5.2	46.3	0.4
5 00NF02ZM0042	1669	25-JUL-90	1445	6.1	8.50		19.6	5.9	49.5	0.5
6 00NF02ZM0042	1868	07-AUG-90	1140	6.2	9.37	54.7	16.7	6.1	52.0	0.6
7 TRIBUTARY- YELLOW MARSH										
8 00NF02ZM0046	309	26-APR-90	1405	5.5	13.10	44.6	3.0	5.3	42.2	0.4
9 00NF02ZM0046	497	24-MAY-90	1410	5.3	13.20		2.9	5.2	34.5	0.2
10 00NF02ZM0046	965	22-JUN-90	1210	5.6	11.10		10.0	5.6	35.4	0.4
11 00NF02ZM0046	966	22-JUN-90	1215	5.6	11.10		10.0	5.6	35.4	0.4
12 00NF02ZM0046	967	22-JUN-90	1220	5.6	11.10		10.0	5.6	36.0	0.4
13 00NF02ZM0046	1670	25-JUL-90	1545	6.3	8.80		18.8	6.1	39.6	0.4
14 00NF02ZM0046	1869	07-AUG-90	1400	6.5	9.30	41.3	17.5	6.2	40.0	0.6
15 TRIBUTARY- NAGLES BROOK										
16 00NF02ZM0070	310	26-APR-90	1455	5.4	12.30	43.1	4.0	5.4	39.8	0.3
17 00NF02ZM0070	498	24-MAY-90	1440	5.2	12.40		3.4	5.2	36.3	0.2
18 00NF02ZM0070	499	24-MAY-90	1445	5.2	12.40		3.4	5.2	36.2	0.2
19 00NF02ZM0070	500	24-MAY-90	1450	5.2	12.40		3.4	5.2	36.2	0.2
20 00NF02ZM0070	968	22-JUN-90	1345	5.4	9.60		12.1	5.5	35.2	0.4
21 00NF02ZM0070	1671	25-JUL-90	1610	6.0	8.40		18.4	6.1	38.2	0.6
22 00NF02ZM0070	1880	08-AUG-90	1445	6.3	8.28	39.6	18.9	6.2	40.0	0.6
23 VIRGINIA RIVER										
24 00NF02ZM0098	311	26-APR-90	1600	5.1	12.50	28.2	3.0	5.2	47.0	0.5
25 00NF02ZM0098	501	24-MAY-90	1530	5.0	12.20		2.5	5.1	36.6	0.3
26 00NF02ZM0098	969	22-JUN-90	1415	5.3	10.40		9.9	5.3	39.4	0.3
27 00NF02ZM0098	1672	25-JUL-90	1640	6.0	8.10		21.6	6.0	45.0	0.5
28 00NF02ZM0098	1890	13-AUG-90	1645	6.3	7.64	51.9	25.3	6.3	50.0	1.1

TABLE 12
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES,
MAJOR IONS, METALS AND NUTRIENTS AT SHORT-TERM
PRESURVEY HEADWATER SITES

STATION	TOTAL ALKALIN MG/L	APPARENT COLOUR REL UNITS	DISS CALCIUM MG/L	DISS MAGNES MG/L	DISS POTASS MG/L	DISS SODIUM MG/L	DISS CHLORIDE MG/L	DISS SULPHATE MTB MG/L	DISS SULPHATE MG/L	SILICA (MB) MG/L
1 LEARYS BROOK										
2 00NF02ZM0042	-0.3	40	0.75	0.67	0.60	6.9	11.00	4.85	4.2	2.8
3 00NF02ZM0042	0.2	35	0.53	0.50	0.40	4.8	6.94	4.60	3.7	2.0
4 00NF02NF0042	0.5	100	0.70	0.57	0.19	6.1	9.10	3.32	1.9	1.8
5 00NF02ZM0042	1.8	50	0.92	0.60	0.22	6.8	11.50	1.52	1.2	3.8
6 00NF02ZM0042	2.5	70	1.10	0.72	0.23	7.2	13.40	1.95	1.5	4.5
7 TRIBUTARY- YELLOW MARSH										
8 00NF02ZM0046	0.2	10	0.70	0.60	0.50	5.4	8.00	4.76	4.6	3.9
9 00NF02ZM0046	0.2	10	0.53	0.50	0.39	4.1	5.50	4.04	3.9	3.2
10 00NF02ZM0046	0.8	10	0.62	0.50	0.18	4.8	6.50	3.22	2.7	3.2
11 00NF02ZM0046	0.5	10	0.63	0.50	0.18	4.8	6.60	3.20	2.8	3.2
12 00NF02ZM0046	0.5	10	0.63	0.50	0.18	4.8	6.40	3.10	2.7	3.2
13 00NF02ZM0046		5	0.76	0.52	0.22	5.4	8.20	2.35	2.5	3.9
14 00NF02ZM0046	1.9	10	0.78	0.54	0.25	5.6	8.80	2.28	2.6	4.3
15 TRIBUTARY- NAGLES BROOK										
16 00NF02ZM0070	0.2	10	0.72	0.59	0.38	5.0	7.80	3.98	3.8	1.9
17 00NF02ZM0070	0.3	10	0.59	0.54	0.30	4.3	6.30	3.73	3.6	1.8
18 00NF02ZM0070	0.1	10	0.61	0.55	0.30	4.5	6.20	3.80	3.6	1.8
19 00NF02ZM0070	0.4	10	0.66	0.50	0.31	4.5	6.20	4.01	3.6	1.8
20 00NF02ZM0070	0.2	10	0.60	0.46	0.13	4.6	6.40	3.08	3.3	1.0
21 00NF02ZM0070		5	0.90	0.51	0.19	5.0	7.60	2.15	2.1	2.1
22 00NF02ZM0070	3.0	L5.	1.20	0.57	0.23	5.4	7.00	2.24	2.2	3.1
23 VIRGINIA RIVER										
24 00NF02ZM0098	0.1	10	0.80	0.65	0.46	5.7	8.80	5.22	4.9	3.3
25 00NF02ZM0098	0.2	20	0.63	0.53	0.35	4.5	5.40	4.44	4.2	2.8
26 00NF02ZM0098	0.3	25	0.70	0.53	0.22	5.0	9.10	3.70	3.9	2.8
27 00NF02ZM0098	2.9	10	1.30	0.64	0.23	5.7	8.80	2.34	2.2	3.7
28 00NF02ZM0098	3.7	40	1.70	0.86	0.25	6.2	7.90	3.76	2.4	3.9

TABLE 12
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES,
MAJOR IONS, METALS AND NUTRIENTS AT SHORT-TERM
PRESURVEY HEADWATER SITES

STATION	TOTAL PHOSPH MG/L	DISS NITRO NO3,NO2 MG/L	TOTAL NITRO MG/L	DISS ORG CARBON MG/L	EXTRBLE ALUMINUM MG/L	EXTRBLE IRON MG/L	EXTRBLE MANGANESE MG/L	EXTRBLE COPPER MG/L	EXTRBLE ZINC MG/L
1 LEARYS BROOK									
2 00NF02ZM0042	0.004	L.01	0.14	5.9	0.120	0.29	0.10	L.002	L.01
3 00NF02ZM0042	0.001	0.01	0.13	5.2	0.100	0.16	0.06	L.002	L.01
4 00NF02NF0042	0.003	L.01	0.15	9.0	0.170	0.46	0.10	L.002	L.01
5 00NF02ZM0042	0.006	L.01	0.16	5.4	0.120	0.70	0.44	L.002	L.01
6 00NF02ZM0042	0.007	L.01	0.18	6.0	0.150	1.30	0.75	L.002	L.01
7 TRIBUTARY- YELLOW MARSH									
8 00NF02ZM0046	0.004	0.03	0.11	3.4	0.160	0.14	0.08	0.002	L.01
9 00NF02ZM0046	0.001	L.01	0.10	4.2	0.140	0.09	0.07	L.002	L.01
10 00NF02ZM0046	0.002	L.01	0.09	4.8	0.140	0.23	0.06	L.002	L.01
11 00NF02ZM0046	0.001	L.01	0.10	4.5	0.140	0.24	0.06	L.002	L.01
12 00NF02ZM0046	L.001	L.01	0.09	4.4	0.140	0.24	0.06	L.002	L.01
13 00NF02ZM0046	0.003	L.01	0.11	2.6	0.068	0.35	0.03	L.002	L.01
14 00NF02ZM0046	0.003	L.01	0.09	2.5	0.080	0.51	0.04	L.002	L.01
15 TRIBUTARY- NAGLES BROOK									
16 00NF02ZM0070	0.001	L.01	0.12	3.1	0.100	0.06	0.03	L.002	L.01
17 00NF02ZM0070	0.001	L.01	0.09	3.7	0.110	0.05	0.03	L.002	L.01
18 00NF02ZM0070	0.001	L.01	0.09	3.6	0.120	0.07	0.03	L.002	L.01
19 00NF02ZM0070	0.001	L.01	0.09	4.4	0.110	0.07	0.03	L.002	L.01
20 00NF02ZM0070	L.001	L.01	0.10	3.6	0.130	0.16	0.04	L.002	L.01
21 00NF02ZM0070	0.003	L.01	0.11	2.9	0.093	0.30	0.06	L.002	L.01
22 00NF02ZM0070	0.005	L.01	0.10	7.6	0.094	0.76	0.16	L.002	L.01
23 VIRGINIA RIVER									
24 00NF02ZM0098	0.004	0.03	0.11	4.5	0.120	0.16	0.13	L.002	L.01
25 00NF02ZM0098	0.001	L.01	0.11	5.1	0.150	0.15	0.07	L.002	L.01
26 00NF02ZM0098	L.001	L.01	0.10	5.4	0.160	0.27	0.09	L.002	L.01
27 00NF02ZM0098	0.004	L.01	0.11	4.7	0.140	0.57	0.24	L.002	L.01
28 00NF02ZM0098	0.005	L.01	0.16	4.7	0.140	1.20	0.46	L.002	L.01

TABLE 12
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF PHYSICAL VARIABLES,
MAJOR IONS, METALS AND NUTRIENTS AT SHORT-TERM
PRESURVEY HEADWATER SITES

STATION	EXTRBLE CADIUM MG/L	EXTRBLE LEAD MG/L	TOTAL ARSENIC MG/L	EXTRBLE MERCURY MG/L
1 LEARYS BROOK				
2 00NF02ZM0042	L.001	L.002	L.0005	L.02
3 00NF02ZM0042	L.001	L.002	L.0005	L.02
4 00NF02NF0042	L.001	L.002	L.0005	L.02
5 00NF02ZM0042	L.001	L.002	0.0005	L.02
6 00NF02ZM0042	L.001	L.002	L.0005	L.02
7 TRIBUTARY- YELLOW MARSH				
8 00NF02ZM0046	L.001	L.002	L.0005	L.02
9 00NF02ZM0046	L.001	L.002	L.0005	L.02
10 00NF02ZM0046	L.001	L.002	L.0005	L.02
11 00NF02ZM0046	L.001	L.002	L.0005	L.02
12 00NF02ZM0046	L.001	L.002	L.0005	L.02
13 00NF02ZM0046	L.001	L.002	L.0005	L.02
14 00NF02ZM0046	L.001	L.002	L.0005	L.02
15 TRIBUTARY- NAGLES BROOK				
16 00NF02ZM0070	L.001	L.002	L.0005	L.02
17 00NF02ZM0070	L.001	L.002	L.0005	L.02
18 00NF02ZM0070	L.001	L.002	L.0005	L.02
19 00NF02ZM0070	L.001	L.002	L.0005	L.02
20 00NF02ZM0070	L.001	L.002	L.0005	L.02
21 00NF02ZM0070	L.001	L.002	0.0005	L.02
22 00NF02ZM0070	L.001	L.002	L.0005	L.02
23 VIRGINIA RIVER				
24 00NF02ZM0098	L.001	L.002	L.0005	L.02
25 00NF02ZM0098	L.001	L.002	L.0005	L.02
26 00NF02ZM0098	L.001	L.002	L.0005	L.02
27 00NF02ZM0098	L.001	L.002	L.0005	L.02
28 00NF02ZM0098	L.001	L.002	L.0005	L.02

TABLE 13
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER COLIFORM BACTERIA CONCENTRATIONS
NO./100ml

	STATION	SAMPLE NUMBER	SAMPLE DATE	SAMPLE TIME	TOTAL COLIFORM	FECAL COLIFORM
1	LEARYS BROOK					
2	00NF02ZM0042	5160	07-AUG-90	1141	80	20
3	00NF02ZM0128	5167	08-AUG-90	1146	40	10
4	00NF02ZM0127	5166	08-AUG-90	1036	740	260
5	00NF02ZM0129	5168	08-AUG-90	1202	700	L10.
6	00NF02ZM0125	5164	07-AUG-90	1631	1600	210
7	YELLOW MARSH STREAM					
8	00NF02ZM0046	5161	07-AUG-90	1401	240	60
9	00NF02ZM0123	5162	07-AUG-90	1415	50000	5000
10	00NF02ZM0126	5165	07-AUG-90	1646	4200	1200
11	LEARYS BROOK					
12	00NF02ZM0124	5163	07-AUG-90	1531	12200	3400
13	00NF02ZM0130	5169	08-AUG-90	1331	15800	2300
14	00NF02ZM0138	5174	13-AUG-90	1046	5000	800
15	NAGLES POND					
16	00NF02ZM0070	5170	08-AUG-90	1446	1600	30
17	00NF02ZM0131	5171	08-AUG-90	1516	120	20
18	RENNIES RIVER					
19	00NF02ZM0133	5173	08-AUG-90	1701	80	10
20	00NF02ZM0132	5172	08-AUG-90	1646	280	20
21	00NF02ZM0144	5179	14-AUG-90	931	G1600.	G600.
22	00NF02ZM0145	5183	14-AUG-90	1216	G1600.	G600.
23	00NF02ZM0016	5182	14-AUG-90	1201	G1600.	G600.
24	VIRGINIA RIVER BASIN					
25	00NF02ZM0098	5178	13-AUG-90	1646	100	L10.
26	00NF02ZM0143	5177	13-AUG-90	1631	240	40
27	00NF02ZM0141	5175	13-AUG-90	1431	26000	1000
28	00NF02ZM0142	5176	13-AUG-90	1446	180	10
29	00NF02ZM0146	5184	14-AUG-90	1431	G1600.	G600.
30	00NF02ZM0147	5185	14-AUG-90	1501	G1600.	G600.
31	00NF02ZM0148	5186	14-AUG-90	1531	G1600.	G600.
32	00NF02ZM0014	5181	14-AUG-90	1120	G1600	G600
33	QUIDI VIDI LAKE					
34	00NF02ZM0015	5180	14-AUG-90	1045	500	130

TABLE 14
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF CHLORINATED HYDROCARBONS,
CHLORINATED BENZENES, POLYNUCLEAR AROMATIC HYDROCARBONS, AND
CHLORINATED PHENOLS IN NG/L

STATION	SAMPLE DATE	ALPHA BHC	GAMMA BHC	HEPTA-CHLOR	ALDRIN	HEPTA-CHLOR-EPOXIDE	GAMMA CHLORDANE	ALPHA CHLORDANE	ALPHA ENDOSULFAN
1 00NF02ZM0127	08-AUG-90	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4
2 00NF02ZM0123	07-AUG-90	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4
3 00NF02ZM0124	07-AUG-90	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4
4 00NF02ZM0130	08-AUG-90	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4
5 00NF02ZM0138	13-AUG-90	0.5	L.4	L.4	L.4	L.4	L.4	L.4	L.4
6 00NF02ZM0133	08-AUG-90	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4
7 00NF02ZM0144	14-AUG-90								
8 00NF02ZM0016	14-AUG-90	0.7	L.4	L.4	L.4	L.4	L.4	L.4	L.4
9 00NF02ZM0142	13-AUG-90	0.7	L.4	L.4	L.4	L.4	L.4	L.4	L.4
10 00NF02ZM0014	14-AUG-90	0.4	0.5	L.4	L.4	L.4	L.4	L.4	L.4
11 00NF02ZM0015	14-AUG-90	0.8	0.5	L.4	L.4	L.4	L.4	L.4	L.4

STATION	PP-DDE	HEOD\ DIELDRIN	ENDRIN	OP-DDT	PP-TDE	PP-DDT	BETA-ENDO-SULFAN	MIREX	METHOXY CHLOR	TOTAL PCB'S
1 00NF02ZM0127	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0
2 00NF02ZM0123	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0
3 00NF02ZM0124	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0
4 00NF02ZM0130	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	12.3
5 00NF02ZM0138	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	19.0
6 00NF02ZM0133	L.4	0.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	20.1
7 00NF02ZM0144										
8 00NF02ZM0016	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0
9 00NF02ZM0142	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	11.0
10 00NF02ZM0014	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0
11 00NF02ZM0015	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0

TABLE 14
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF CHLORINATED HYDROCARBONS,
CHLORINATED BENZENES, POLYNUCLEAR AROMATIC HYDROCARBONS, AND
CHLORINATED PHENOLS IN NG/L

STATION	1,3 DI-CHLORO-BENZENE	1,4 DI-CHLORO-BENZENE	1,2 DI-CHLORO-BENZENE	1,3,5 TRI-CHLORO-BENZENE	1,2,4 TRI-CHLORO-BENZENE	1,2,3 TRI-CHLORO-BENZENE	1,2,3,4 TETRA-CHLORO-BENZENE	HEXA-CHLORO-BENZENE	PENTA-CHLORO-BENZENE
1 00NF02ZM0127	L5.0	16.1	7.4	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
2 00NF02ZM0123	L5.0	11.1	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
3 00NF02ZM0124	L5.0	12.3	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
4 00NF02ZM0130	L5.0	30.3	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
5 00NF02ZM0138	L5.0	32.5	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
6 00NF02ZM0133	L5.0	14.8	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
7 00NF02ZM0144									
8 00NF02ZM0016	L5.0	25.5	L5.0	L.1	4.6	L1.0	L1.0	L.4	L1.0
9 00NF02ZM0142	L5.0	10.6	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
10 00NF02ZM0014	L5.0	11.9	L5.0	L.1	L1.0	L1.0	L1.0	L.4	L1.0
11 00NF02ZM0015	L5.0	14.7	L5.0	L.1	L1.0	L1.0	L1.0	L.4	L1.0

STATION	INDENE	1,2,3,4-TETRAHYDRO-NAPHTALENE	2-METHYL-NAPHTA-LENE	1-METHYL-NAPHTA-LENE	B-CHLORO-NAPHTA-LENE	ACENAPH-THYLENE	ACENAPH-THENE	FLUORENE	PHENAN-THRENE
1 00NF02ZM0127	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
2 00NF02ZM0123	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
3 00NF02ZM0124	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
4 00NF02ZM0130	L10.0	L10.0	23.6	20.8	L10.0	L10.0	L10.0	L15.0	L15.0
5 00NF02ZM0138	L10.0	10	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
6 00NF02ZM0133	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
7 00NF02ZM0144									
8 00NF02ZM0016	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
9 00NF02ZM0142	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
10 00NF02ZM0014	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
11 00NF02ZM0015	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0

TABLE 14
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF CHLORINATED HYDROCARBONS,
CHLORINATED BENZENES, POLYNUCLEAR AROMATIC HYDROCARBONS, AND
CHLORINATED PHENOLS IN NG/L

STATION	SAMPLE DATE	ALPHA BHC	GAMMA BHC	HEPTA- CHLOR	ALDRIN	HEPTA- CHLOR- EPOXIDE	GAMMA CHLORDANE	ALPHA CHLORDANE	ALPHA ENDOSULFAN
1 00NF02ZM0127	08-AUG-90	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4
2 00NF02ZM0123	07-AUG-90	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4
3 00NF02ZM0124	07-AUG-90	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4
4 00NF02ZM0130	08-AUG-90	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4
5 00NF02ZM0138	13-AUG-90	0.5	L.4	L.4	L.4	L.4	L.4	L.4	L.4
6 00NF02ZM0133	08-AUG-90	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4
7 00NF02ZM0144	14-AUG-90								
8 00NF02ZM0016	14-AUG-90	0.7	L.4	L.4	L.4	L.4	L.4	L.4	L.4
9 00NF02ZM0142	13-AUG-90	0.7	L.4	L.4	L.4	L.4	L.4	L.4	L.4
10 00NF02ZM0014	14-AUG-90	0.4	0.5	L.4	L.4	L.4	L.4	L.4	L.4
11 00NF02ZM0015	14-AUG-90	0.8	0.5	L.4	L.4	L.4	L.4	L.4	L.4

STATION	PP- DDE	HEOD\ DIELDRIN	ENDRIN	OP- DDT	PP- TDE	PP- DDT	BETA- ENDO- SULFAN	MIREX	METHOXY CHLOR	TOTAL PCB'S
1 00NF02ZM0127	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0
2 00NF02ZM0123	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0
3 00NF02ZM0124	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0
4 00NF02ZM0130	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	12.3
5 00NF02ZM0138	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	19.0
6 00NF02ZM0133	L.4	0.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	20.1
7 00NF02ZM0144										
8 00NF02ZM0016	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0
9 00NF02ZM0142	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	11.0
10 00NF02ZM0014	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0
11 00NF02ZM0015	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0

TABLE 14
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF CHLORINATED HYDROCARBONS,
CHLORINATED BENZENES, POLYNUCLEAR AROMATIC HYDROCARBONS, AND
CHLORINATED PHENOLS IN NG/L

STATION	1,3 DI-CHLORO-BENZENE	1,4 DI-CHLORO-BENZENE	1,2 DI-CHLORO-BENZENE	1,3,5 TRI-CHLORO-BENZENE	1,2,4 TRI-CHLORO-BENZENE	1,2,3 TRI-CHLORO-BENZENE	1,2,3,4 TETRA-CHLORO-BENZENE	HEXA-CHLORO-BENZENE	PENTA-CHLORO-BENZENE
1 00NF02ZM0127	L5.0	16.1	7.4	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
2 00NF02ZM0123	L5.0	11.1	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
3 00NF02ZM0124	L5.0	12.3	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
4 00NF02ZM0130	L5.0	30.3	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
5 00NF02ZM0138	L5.0	32.5	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
6 00NF02ZM0133	L5.0	14.8	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
7 00NF02ZM0144									
8 00NF02ZM0016	L5.0	25.5	L5.0	L.1	4.6	L1.0	L1.0	L.4	L1.0
9 00NF02ZM0142	L5.0	10.6	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0
10 00NF02ZM0014	L5.0	11.9	L5.0	L.1	L1.0	L1.0	L1.0	L.4	L1.0
11 00NF02ZM0015	L5.0	14.7	L5.0	L.1	L1.0	L1.0	L1.0	L.4	L1.0

STATION	INDENE	1,2,3,4-TETRAHYDRO-NAPHTALENE	2-METHYL-NAPHTA-LENE	1-METHYL-NAPHTA-LENE	B-CHLORO-NAPHTA-LENE	ACENAPH-THYLENE	ACENAPH-THENE	FLUORENE	PHENAN-THRENE
1 00NF02ZM0127	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
2 00NF02ZM0123	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
3 00NF02ZM0124	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
4 00NF02ZM0130	L10.0	L10.0	23.6	20.8	L10.0	L10.0	L10.0	L15.0	L15.0
5 00NF02ZM0138	L10.0	10	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
6 00NF02ZM0133	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
7 00NF02ZM0144									
8 00NF02ZM0016	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
9 00NF02ZM0142	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
10 00NF02ZM0014	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0
11 00NF02ZM0015	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0

TABLE 14
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF CHLORINATED HYDROCARBONS,
CHLORINATED BENZENES, POLYNUCLEAR AROMATIC HYDROCARBONS, AND
CHLORINATED PHENOLS IN NG/L

STATION	PYRENE	FLUOR-ANTHENE	BENZO(b)-FLUOR-ANTHENE	BENZO(k)-FLUOR-ANTHENE	BENZO(a)-PYRENE	INDENO-(1,2,3-cd) PYRENE	BENZO(g,h,i) PERYLENE	O-CHLORO-PHENOL	M-CHLORO-PHENOL
1 00NF02ZM0127	L15.0	L15.0	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50
2 00NF02ZM0123	L15.0	L15.0	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50
3 00NF02ZM0124	L15.0	L15.0	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50
4 00NF02ZM0130	L15.0	L15.0	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50
5 00NF02ZM0138	L15.0	L15.0	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50
6 00NF02ZM0133	L15.0	L15.0	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50
7 00NF02ZM0144								L65	L50
8 00NF02ZM0016	L15.0	L15.0	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50
9 00NF02ZM0142	L15.0	L15.0	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50
10 00NF02ZM0014	L15.0	L15.0	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50
11 00NF02ZM0015	L15.0	L15.0	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50

STATION	P-CHLORO-PHENOL	2 CL-5-METHYL-PHENOL	2,6 DI-CHLORO-PHENOL	3 MET-4 CHLORO-PHENOL	2,4 DI-CHLORO-PHENOL	3,5 DI-CHLORO-PHENOL	2,3 DI-CHLORO-PHENOL	3,4 DI-CHLORO-PHENOL	2,4,6 TRI-CHLORO-PHENOL
1 00NF02ZM0127	L40	L105	L55	L65	L50	L35	L65	L40	L50
2 00NF02ZM0123	L40	L105	L55	L65	L50	L35	L65	L40	L50
3 00NF02ZM0124	L40	L105	L55	L65	L50	L35	L65	L40	L50
4 00NF02ZM0130	L40	L105	L55	L65	L50	L35	L65	L40	L50
5 00NF02ZM0138	L40	L105	L55	L65	L50	L35	L65	L40	L50
6 00NF02ZM0133	L40	L105	L55	L65	L50	L35	L65	L40	L50
7 00NF02ZM0144	L40	L105	L55	L65	L50	L35	L65	L40	L50
8 00NF02ZM0016	L40	L105	L55	L65	L50	L35	L65	L40	L50
9 00NF02ZM0142	L40	L105	L55	L65	L50	L35	L65	L40	L50
10 00NF02ZM0014	L40	L105	L55	L65	L50	L35	L65	L40	L50
11 00NF02ZM0015	L40	L105	L55	L65	L50	L35	L65	L40	L50

TABLE 14
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SURFACE WATER ANALYSIS OF CHLORINATED HYDROCARBONS,
CHLORINATED BENZENES, POLYNUCLEAR AROMATIC HYDROCARBONS, AND
CHLORINATED PHENOLS IN NG/L

STATION	2,3,6 TRI-CHLORO-PHENOL	2,3,5 TRI-CHLORO-PHENOL	2,4,5 TRI-CHLORO-PHENOL	2,3,4 TRI-CHLORO-PHENOL	3,4,5 TRI-CHLORO-PHENOL	2,3,5,6 TET-RACHLORO-PHENOL	2,3,4,6 TET-RACHLORO-PHENOL	2,3,4,5 TET-RACHLORO-PHENOL
1 00NF02ZM0127	L65	L55	L45	L60	L70	L80	L60	L90
2 00NF02ZM0123	L65	L55	L45	L60	L70	L80	L60	L90
3 00NF02ZM0124	L65	L55	L45	L60	L70	L80	L60	L90
4 00NF02ZM0130	L65	L55	L45	L60	L70	L80	L60	L90
5 00NF02ZM0138	L65	L55	L45	L60	L70	L80	L60	L90
6 00NF02ZM0133	L65	L55	L45	L60	L70	L80	L60	L90
7 00NF02ZM0144	L65	L55	L45	L60	L70	L80	L60	L90
8 00NF02ZM0016	L65	L55	L45	L60	L70	L80	L60	L90
9 00NF02ZM0142	L65	L55	L45	L60	L70	L80	L60	L90
10 00NF02ZM0014	L65	L55	L45	L60	L70	L80	L60	L90
11 00NF02ZM0015	L65	L55	L45	L60	L70	L80	L60	L90

STATION	PENTA-CHLORO-PHENOL	VOLUME (Lt)
1 00NF02ZM0127	L85	3.56
2 00NF02ZM0123	L85	3.74
3 00NF02ZM0124	L85	3.94
4 00NF02ZM0130	L85	3.46
5 00NF02ZM0138	L85	3.62
6 00NF02ZM0133	L85	3.98
7 00NF02ZM0144	L85	
8 00NF02ZM0016	L85	3.72
9 00NF02ZM0142	L85	3.70
10 00NF02ZM0014	L85	3.75
11 00NF02ZM0015	L85	3.62

TABLE 15
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SEDIMENT ANALYSIS OF PARTICLE SIZE (%), ORGANIC CONTENT (%)
METALS (MG/KG), AND OIL CONTENT (%)

STATION	SAMPLE DATE	SAND (%)	SILT (%)	CLAY (%)	O.CARBON PARTIC %	O.NITRO PARTIC %	EXTRBLE ALUMINUM MG/KG	EXTRBLE CADMIUM MG/KG	EXTRBLE COBALT MG/KG	EXTRBLE CHROMIUM MG/KG	EXTRBLE COPPER MG/KG
1 51NF02ZM0136	10-AUG-90	69.8	15.4	14.8	2.16	0.25	6720	L.2	16.80	1.05	8.28
2 51NF02ZM0136	10-AUG-90				4.36	0.52	6220	L.2	15.00	1.03	7.85
3 51NF02ZM0136	10-AUG-90				4.99	0.59	6570	L.2	15.90	0.90	8.55
4 51NF02ZM0137	13-AUG-90	69.0	9.0	22.0	24.50	2.88	23400	L.2	9.54	1.22	12.50
5 51NF02ZM0137	13-AUG-90				21.80	2.60	23600	0.33	9.71	1.71	8.70
6 51NF02ZM0137	13-AUG-90				22.10	2.62	22700	0.35	9.56	1.32	9.55
7 51NF02ZM0134	09-AUG-90	12.0	70.0	18.0	6.29	0.75	8730	1.28	8.60	5.68	54.00
8 51NF02ZM0134	09-AUG-90				6.19	0.73	8480	1.21	8.28	5.34	52.20
9 51NF02ZM0134	09-AUG-90				6.35	0.77	8990	1.23	8.24	5.58	52.40
10 51NF02ZM0139	13-AUG-90	45.8	35.4	18.8	12.10	1.47	9980	1.92	48.10	4.59	60.20
11 51NF02ZM0139	13-AUG-90				9.50	1.19	13000	2.24	53.50	15.70	42.40
12 51NF02ZM0139	13-AUG-90				12.40	1.53	10400	1.95	50.30	4.63	63.80
13 51NF02ZM0135	10-AUG-90	14.6	54.8	30.6	7.36	0.97	8800	2.34	37.20	3.12	62.50
14 51NF02ZM0135	10-AUG-90				7.09	0.94	9010	2.25	39.50	3.21	62.60
15 51NF02ZM0135	10-AUG-90				7.89	1.02	8680	2.30	37.00	2.99	61.40
16 51NF02ZM0140	13-AUG-90	56.2	33.1	10.7	1.24	0.15	2870	0.36	3.72	1.64	17.80
17 51NF02ZM0140	13-AUG-90				2.00	0.24	3070	0.36	4.09	1.72	19.50
18 51NF02ZM0140	13-AUG-90				1.46	0.18	3150	0.37	3.76	1.86	19.20

STATION	NONRESID IRON MG/KG	NONRESID MANGANESE MG/KG	NONRESID NICKEL MG/KG	EXTRBLE LEAD MG/KG	NONRESID ZINC MG/KG	TOTAL ARSENIC MG/KG	TOTAL SELENIUM MG/KG	TOTAL MERCURY MG/KG	GREASE/ OILS %
1 51NF02ZM0136	17700	480	L.6	17.7	25.1	30.1	1.3	0.08	L.1
2 51NF02ZM0136	16500	427	L.6	16.1	25.1	34.9	1.2	0.07	0.2
3 51NF02ZM0136	16400	452	L.6	17.1	25.3	30.1	1.2	0.08	0.2
4 51NF02ZM0137	4140	375	2.55	26.6	45.8	13.9	5.2	0.29	0.3
5 51NF02ZM0137	4250	387	3.07	26.6	47.6	17.5	5.6	0.19	0.3
6 51NF02ZM0137	4570	408	2.81	30.6	61.0	15.3	5.1	0.29	0.4
7 51NF02ZM0134	19100	636	3.74	348.0	725.0	9.8	1.3	0.26	1.3
8 51NF02ZM0134	18500	592	3.34	334.0	370.0	9.8	1.3	0.23	1.0
9 51NF02ZM0134	19000	631	3.99	337.0	308.0	9.6	1.3	0.23	1.0
10 51NF02ZM0139	29600	8360	11.20	260.0	631.0	16.1	1.8	0.32	0.2
11 51NF02ZM0139	41900	9650	12.80	261.0	737.0	17.2	2.0	0.32	0.4
12 51NF02ZM0139	29400	8330	11.50	273.0	677.0	17.3	2.1	0.30	0.4
13 51NF02ZM0135	33700	30200	20.40	309.0	469.0	15.7	1.9	0.20	0.4
14 51NF02ZM0135	35400	32900	21.20	316.0	485.0	15.1	1.8	0.24	0.4
15 51NF02ZM0135	33800	28700	20.00	292.0	462.0	15.0	1.9	0.21	1.3
16 51NF02ZM0140	4050	299	1.24	38.0	161.0	4.0	0.6	0.39	0.2
17 51NF02ZM0140	4710	333	1.30	44.0	179.0	4.1	0.6	0.27	0.2
18 51NF02ZM0140	4770	338	1.42	43.2	182.0	4.1	0.6	0.31	0.2

TABLE 16

QUIDI VIDI BASIN RECURRENT SURVEY 1990

SEDIMENT ANALYSIS OF ORGANIC COMPOUNDS - POLYNUCLEAR AROMATIC HYDROCARBONS, CHLORINATED PHENOLS, CHLORINATED HYDROCARBONS, AND CHLORINATED BENZENES IN NG/G

STATION	SAMPLE DATE	INDENE	1,2,3,4-TETRAHYDRO-NAPHTHALENE	2-METHYL-NAPHTHA-LENE	1-METHYL-NAPHTHA-LENE	B-CHLORO-NAPHTHA-LENE	ACENAPH-THYLENE	ACENAPH-THENE	FLUORENE
1 50NF02ZM0136	10-AUG-90	L10	L10	L10	L10	L10	L10	L10	L15
2 50NF02ZM0136	10-AUG-90	L10	L10	L10	L10	L10	L10	L10	L15
3 50NF02ZM0136	10-AUG-90	L10	L10	L10	L10	L10	L10	L10	L15
4 50NF02ZM0137	13-AUG-90	L10	L10	L10	L10	L10	L10	L10	L15
5 50NF02ZM0137	13-AUG-90	L10	L10	L10	L10	L10	L10	L10	L15
6 50NF02ZM0137	13-AUG-90	L10	L10	L10	L10	L10	L10	L10	L15
7 50NF02ZM0134	09-AUG-90	L10	L10	L10	L10	L10	10.2	L10	L15
8 50NF02ZM0134	09-AUG-90	L10	L10	L10	L10	L10	15.3	L10	L15
9 50NF02ZM0134	09-AUG-90	L10	L10	L10	L10	L10	L10	L10	L15
10 50NF02ZM0139	13-AUG-90	L10	L10	23.4	24.4	L10	21.2	63.2	103
11 50NF02ZM0139	13-AUG-90	L10	L10	14.2	15	L10	21.7	32.4	69
12 50NF02ZM0139	13-AUG-90	L10	L10	30.1	33.4	L10	31.2	114	284
13 50NF02ZM0135	10-AUG-90	L10	L10	L10	L10	L10	L10	L10	L15
14 50NF02ZM0135	10-AUG-90	L10	L10	L10	L10	L10	L10	L10	L15
15 50NF02ZM0135	10-AUG-90	L10	L10	L10	L10	L10	L10	L10	L15
16 50NF02ZM0140	13-AUG-90	L10	L10	L10	L10	L10	L10	L10	39.7
17 50NF02ZM0140	13-AUG-90	L10	L10	L10	L10	L10	L10	13.9	16.9
18 50NF02ZM0140	13-AUG-90	L10	L10	L10	L10	L10	L10	13.3	17.1

STATION	PHENAN-THRENE	PYRENE	FLUOR-ANTHENE	BENZO(b)-FLUOR-ANTHENE	BENZO(k)-FLUOR-ANTHENE	BENZO(a)-PYRENE	INDENO-PYRENE	BENZO-PERY-LENE	O-CHLORO-PHENOL
1 50NF02ZM0136	L15	L15	L15	L30	L30	L30	L30	L30	L.5
2 50NF02ZM0136	L15	L15	L15	L30	L30	L30	L30	L30	L.5
3 50NF02ZM0136	L15	L15	L15	L30	L30	L30	L30	L30	L.5
4 50NF02ZM0137	L15	28.8	82.4	L30	L30	L30	L30	L30	L.5
5 50NF02ZM0137	L15	16.2	49.4	L30	L30	L30	L30	L30	L.5
6 50NF02ZM0137	L15	15.4	45.4	L30	L30	L30	L30	L30	L.5
7 50NF02ZM0134	76.9	113	193	L30	52.6	80.1	132	105	L.5
8 50NF02ZM0134	74.2	103	177	L30	46.9	72.9	118	93.7	L.5
9 50NF02ZM0134	69.4	94.2	161	L30	45.3	74.2	136	98.2	1.4
10 50NF02ZM0139	1150	566	1160	400	182	351	560	195	1.2
11 50NF02ZM0139	819	593	1550	593	355	688	994	355	L.5
12 50NF02ZM0139	283	1960	5140	2370	1050	2880	4520	1920	L.5
13 50NF02ZM0135	61.8	51.5	127	L30	L30	49.4	74.7	38.1	0.6
14 50NF02ZM0135	48.6	42.4	108	L30	38.7	57.7	129	56.4	0.7
15 50NF02ZM0135	73.4	56.9	144	L30	33.4	57.9	L98.7	148	1.2
16 50NF02ZM0140	560	463	128	470	230	534	820	414	L.5
17 50NF02ZM0140	398	378	765	396	178	372	720	336	L.5
18 50NF02ZM0140	262	239	675	349	181	337	793	370	L.5

TABLE 16
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SEDIMENT ANALYSIS OF ORGANIC COMPOUNDS - POLYNUCLEAR AROMATIC
HYDROCARBONS, CHLORINATED PHENOLS, CHLORINATED HYDROCARBONS,
AND CHLORINATED BENZENES IN NG/G

STATION	M-CHLORO-PHENOL	P-CHLORO-PHENOL	2 CL-5-METHYL-PHENOL	2,6 DI-CHLORO-PHENOL	3 MET-4 CHLORO-PHENOL	2,4 DI-CHLORO-PHENOL	3,5 DI-CHLORO-PHENOL	2,3 DI-CHLORO-PHENOL	3,4 DI-CHLORO-PHENOL	2,4,6 TRI-CHLORO-PHENOL
1 50NF02ZM0136	L.8	L.5	L1.4	L1.2	L1.4	L.6	L1.5	L.2	1.1	0.8
2 50NF02ZM0136	L.8	L.5	L1.4	L1.2	L1.4	L.6	L1.5	L.2	2	1.2
3 50NF02ZM0136	0.9	0.9	L1.4	L1.2	L1.4	L.6	L1.5	L.2	2.3	1.7
4 50NF02ZM0137	L.8	L.5	L1.4	L1.2	L1.4	L.6	L1.5	L.2	2.7	2.6
5 50NF02ZM0137	L.8	L.5	L1.4	L1.2	L1.4	L.6	L1.5	L.2	4.8	3.4
6 50NF02ZM0137	L.8	L.5	L1.4	1.5	L1.4	L.6	L1.5	L.2	4.5	3.1
7 50NF02ZM0134	L.8	L.5	L1.4	L1.2	L1.4	L.6	5.3	L.2	1	0.9
8 50NF02ZM0134	L.8	0.6	L1.4	L1.2	L1.4	L.6	6.8	L.2	1	2.6
9 50NF02ZM0134	0.9	1	L1.4	1.4	L1.4	3.2	L1.5	3.3	1.9	2.6
10 50NF02ZM0139	L.8	L.5	L1.4	L1.2	L1.4	L.6	L1.5	L.2	1.1	2.2
11 50NF02ZM0139	L.8	L.5	L1.4	L1.2	L1.4	L.6	L1.5	L.2	2.2	4.5
12 50NF02ZM0139	L.8	L.5	L1.4	L1.2	L1.4	L.6	L1.5	L.2	0.9	1.8
13 50NF02ZM0135	L.8	1.7	L1.4	L1.2	L1.4	L.6	13.2	L.2	3.4	L.4
14 50NF02ZM0135	L.8	3	L1.4	L1.2	L1.4	L.6	L1.5	L.2	4.9	L.4
15 50NF02ZM0135	L.8	3.7	L1.4	1.4	L1.4	L.6	20	1.2	8.2	1.6
16 50NF02ZM0140	L.8	0.6	L1.4	L1.2	L1.4	L.6	5	L.2	0.9	1.4
17 50NF02ZM0140	L.8	0.8	L1.4	L1.2	L1.4	L.6	L1.5	L.2	0.8	L.4
18 50NF02ZM0140	L.8	L.5	L1.4	L1.2	L1.4	L.6	L1.5	L.2	L.8	0.9

STATION	2,3,6 TRI-CHLORO-PHENOL	2,3,5 TRI-CHLORO-PHENOL	2,4,5 TRI-CHLORO-PHENOL	2,3,4 TRI-CHLORO-PHENOL	3,4,5 TRI-CHLORO-PHENOL	2,3,5,6 TET-RACHLORO-PHENOL	2,3,4,6 TET-RACHLORO-PHENOL	2,3,4,5 TET-RACHLORO-PHENOL
1 50NF02ZM0136	L1.4	L1.0	L1.0	L.8	L1.0	L1.0	L.6	L1.0
2 50NF02ZM0136	L1.4	L1.0	L1.0	L.8	L1.0	L1.0	L.6	L1.0
3 50NF02ZM0136	L1.4	L1.0	L1.0	L.8	L1.0	L1.0	L.6	L1.0
4 50NF02ZM0137	L1.4	L1.0	L1.0	L.8	L1.0	L1.0	L.6	L1.0
5 50NF02ZM0137	1.9	L1.0	L1.0	L.8	L1.0	1.5	L.6	L1.0
6 50NF02ZM0137	1.9	L1.0	1.7	L.8	L1.0	L1.0	L.6	L1.0
7 50NF02ZM0134	L1.4	L1.0	L1.0	L.8	L1.0	1.7	L.6	L1.0
8 50NF02ZM0134	L1.4	1.1	L1.0	L.8	L1.0	1.6	3.1	3.8
9 50NF02ZM0134	L1.4	1.8	1.4	1.4	3.7	1.9	3.9	3.7
10 50NF02ZM0139	L1.4	1.4	1.5	L.8	L1.0	1.7	L.6	L1.0
11 50NF02ZM0139	L1.4	3.1	2.3	L.8	L1.0	1.8	3.1	2.2
12 50NF02ZM0139	L1.4	4.9	L1.0	L.8	L1.0	1.5	L.6	L1.0
13 50NF02ZM0135	L1.4	L1.0	L1.0	L.8	L1.0	L1.0	L.6	L1.0
14 50NF02ZM0135	L1.4	L1.0	L1.0	L.8	L1.0	L1.0	L.6	L1.0
15 50NF02ZM0135	L1.4	L1.0	L1.0	L.8	L1.0	L1.0	L.6	L1.0
16 50NF02ZM0140	L1.4	27.3	L1.0	1.5	3.2	L1.0	2	3.1
17 50NF02ZM0140	L1.4	37.7	L1.0	1.3	3.4	2	L.6	4
18 50NF02ZM0140	L1.4	6.4	L1.0	L.8	2.3	1.7	L.6	3.3

TABLE 16

QUIDI VIDI BASIN RECURRENT SURVEY 1990

SEDIMENT ANALYSIS OF ORGANIC COMPOUNDS - POLYNUCLEAR AROMATIC HYDROCARBONS, CHLORINATED PHENOLS, CHLORINATED HYDROCARBONS, AND CHLORINATED BENZENES IN NG/G

STATION	PENTA-CHLORO-PHENOL	ALPHA BHC	GAMMA BHC	HEPTA-CHLOR	ALDRIN	HEPTA-CHLOR-EPOXIDE	GAMMA CHLORDANE	ALPHA CHLORDANE	ALPHA ENDOSULFAN	PP-DDE
1 50NF02ZM0136	1.8	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
2 50NF02ZM0136	2.6	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
3 50NF02ZM0136	2.1	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
4 50NF02ZM0137	2.9	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
5 50NF02ZM0137	2.8	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
6 50NF02ZM0137	2.4	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
7 50NF02ZM0134	8.8	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
8 50NF02ZM0134	23.0	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
9 50NF02ZM0134	25.0	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
10 50NF02ZM0139	9.7	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
11 50NF02ZM0139	18.3	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
12 50NF02ZM0139	8.3	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
13 50NF02ZM0135	2.2	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
14 50NF02ZM0135	4.0	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
15 50NF02ZM0135	3.2	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
16 50NF02ZM0140	9.9	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
17 50NF02ZM0140	10.4	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6
18 50NF02ZM0140	12.0	L2.3	L2.9	L1.4	L1.6	L1.9	L1.5	L2.3	L1.4	L5.6

STATION	HEOD\ DIELDRIN	ENDRIN	OP-DDT	PP-TDE	PP-DDT	BETA-ENDO-SULFAN	MIREX	PP-METH-OXYCHLOR	TOTAL PCB'S	1,3 DI-CHLORO-BENZENE
1 50NF02ZM0136	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	L77	L11.1
2 50NF02ZM0136	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	L77	L11.1
3 50NF02ZM0136	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	L77	L11.1
4 50NF02ZM0137	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	L77	L11.1
5 50NF02ZM0137	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	L77	L11.1
6 50NF02ZM0137	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	L77	L11.1
7 50NF02ZM0134	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	43600	L11.1
8 50NF02ZM0134	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	52400	L11.1
9 50NF02ZM0134	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	30700	L11.1
10 50NF02ZM0139	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	2110	37.8
11 50NF02ZM0139	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	3580	L11.1
12 50NF02ZM0139	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	2710	L11.1
13 50NF02ZM0135	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	L77	L11.1
14 50NF02ZM0135	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	77.7	L11.1
15 50NF02ZM0135	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	208	L11.1
16 50NF02ZM0140	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	417	L11.1
17 50NF02ZM0140	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	376	L11.1
18 50NF02ZM0140	L3.2	L2.9	L7	L6	L7.5	L2.9	L4.3	L18	352	L11.1

TABLE 16
QUIDI VIDI BASIN RECURRENT SURVEY 1990
SEDIMENT ANALYSIS OF ORGANIC COMPOUNDS - POLYNUCLEAR AROMATIC HYDROCARBONS, CHLORINATED PHENOLS, CHLORINATED HYDROCARBONS, AND CHLORINATED BENZENES IN NG/G

STATION	1,4 DI-CHLORO-BENZENE	1,2 DI-CHLORO-BENZENE	1,3,5 TRI-CHLORO-BENZENE	1,2,4 TRI-CHLORO-BENZENE	1,2,3 TRI-CHLORO-BENZENE	1,2,3,4-T-ETRACHLO-ROBENZENE	HEXA-CHLORO-BENZENE	PENTA-CHLORO-BENZENE
1 50NF02ZM0136	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
2 50NF02ZM0136	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
3 50NF02ZM0136	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
4 50NF02ZM0137	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
5 50NF02ZM0137	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
6 50NF02ZM0137	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
7 50NF02ZM0134	28.6	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
8 50NF02ZM0134	23.3	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
9 50NF02ZM0134	18.1	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
10 50NF02ZM0139	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
11 50NF02ZM0139	28.5	L14.7	18.7	L3.6	L1.9	L2.7	L6.3	L3.7
12 50NF02ZM0139	18.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
13 50NF02ZM0135	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
14 50NF02ZM0135	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
15 50NF02ZM0135	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
16 50NF02ZM0140	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
17 50NF02ZM0140	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7
18 50NF02ZM0140	L11.7	L14.7	L1.8	L3.6	L1.9	L2.7	L6.3	L3.7

TABLE 17
QUIDI VIDI BASIN RECURRENT SURVEY 1990
FORAGE FISH ANALYSIS OF ORGANOCHLORINES, CHLORINATED BENZENES,
POLYNUCLEAR AROMATIC HYDROCARBONS IN NG/G, METALS IN MG/KG, AND
PERCENT LIPID CONTENT

STATION	SAMPLE DATE	ALPHA BHC	GAMMA BHC	HEPTA-CHLOR	ALDRIN	HEPTA-CHLOR-EPOXIDE	GAMMA CHLORDANE	ALPHA CHLORDANE	ALPHA ENDOSULFAN	PP-DDE
1 90NF02ZM0138	13-AUG-90									
2 90NF02ZM0016	10-AUG-90	L5	L5	L5	L5	L5	L5	L5	L5	L5
3 90NF02ZM0149	14-AUG-90	L5	L5	L5	L5	L5	L5	L5	L5	L5

STATION	HEOD\ DIELDRIN	ENDRIN	OP-DDT	PP-TDE	PP-DDT	BETA-ENDO-SULFAN	MIREX	METHOXY CHLOR	TOTAL PCB'S	1,3 DI-CHLORO-BENZENE	1,4 DI-CHLORO-BENZENE
1 90NF02ZM0138											
2 90NF02ZM0016	6.33	L5	L5	L5	6.77	L5	L5	L5	1160	L50	L50
3 90NF02ZM0149	L5	L5	L5	5.31	6.54	L5	L5	L5	1950	L50	L50

STATION	1,2 DI-CHLORO-BENZENE	1,3,5 TRI-CHLORO-BENZENE	1,2,4 TRI-CHLORO-BENZENE	1,2,3 TRI-CHLORO-BENZENE	1,2,3,4 TETRA-CHLORO-BENZENE	HEXA-CHLORO-BENZENE	PENTA-CHLORO-BENZENE	INDENE	1,2,3,4-TETRAHYDRO NAPHTALENE
1 90NF02ZM0138									
2 90NF02ZM0016	L50	L5	L5	L5	L5	L5	L5	L10	L10
3 90NF02ZM0149	L50	L5	L5	L5	L5	L5	L5	L10	L10

STATION	2-METHYL-NAPHTA-LENE	1-METHYL-NAPHTA-LENE	B-CHLORO-NAPHTA-LENE	ACENAPH-THYLENE	ACENAPH-THENE	FLUORENE	PHENAN-THRENE	PYRENE	FLUOR-ANTHENE	BENZO(b)-FLUOR-ANTHENE
1 90NF02ZM0138										
2 90NF02ZM0016	L10	L10	L10	L10	L10	L10	L10	L10	L10	L10
3 90NF02ZM0149	L10	L10	L10	L10	L10	L10	L10	L10	L10	L10

STATION	BENZO(k)-FLUOR-ANTHENE	BENZO(a)-PYRENE	INDENO-(1,2,3-cd) PYRENE	BENZO(g,h,i) PERYLENE	LIPIDS (%)	MERCURY TOTAL MG/KG	CADMIUM TOTAL MG/KG	CHROMIUM TOTAL MG/KG	COPPER TOTAL MG/KG	NICKEL TOTAL MG/KG
1 90NF02ZM0138					4.5	0.05	0.03	0.24	1.76	L.05
2 90NF02ZM0016	L10	L10	L10	L10	2.0	0.12	0.05	0.32	2.75	0.12
3 90NF02ZM0149	L10	L10	L10	L10	3.2	0.05	0.03	L.2	1.79	L.05

TABLE 17
QUIDI VIDI BASIN RECURRENT SURVEY 1990
FORAGE FISH ANALYSIS OF ORGANOCHLORINES, CHLORINATED BENZENES,
POLYNUCLEAR AROMATIC HYDROCARBONS IN NG/G, METALS IN MG/KG, AND
PERCENT LIPID CONTENT

STATION	LEAD TOTAL MG/KG	ZINC TOTAL MG/KG	ARSENIC TOTAL MG/KG	SELENIUM TOTAL MG/KG
1 90NF02ZM0138	0.17	39.9	L.05	0.49
2 90NF02ZM0016	0.57	49.0	0.19	0.57
3 90NF02ZM0149	L.1	49.7	0.10	0.44

TABLE 18
LONGTERM SURFACE WATER QUALITY DATA FOR RENNIES RIVER STATION
NF02ZM0016, ABOVE THE INLET TO QUIDI VIDI LAKE
1986 - 1990

STATION	DISS SULPHATE MG/L	DISS SULPHATE IC-MG/L	DISS CHLORIDE MG/L	DISS POTASS MG/L	DISS CALCIUM MG/L	EXTRBLE MANGANE MG/L	EXTRBLE IRON MG/L	TOTAL COBALT MG/L	TOTAL NICKEL MG/L
1 00NF02ZM0016	7.800	7.470	69.800	1.100	7.640	0.212	0.419	0.0008	L.0002
2 00NF02ZM0016	11.300	9.800	97.500	0.950	6.910	0.216	1.440	0.0009	0.0010
3 00NF02ZM0016	11.000	10.200	80.300	0.930	6.800	0.183	0.705	0.0005	0.0006
4 00NF02ZM0016	10.900	9.600	79.300	0.930	6.800	0.181	0.617	0.0005	0.0005
5 00NF02ZM0016	10.700	9.110	93.100	1.120		0.033	0.608	0.0005	0.0005
6 00NF02ZM0016	15.200	14.400	259.000	1.170	11.100	0.379	0.541	L.0001	0.0007
7 00NF02ZM0016	11.200	10.700	136.000	1.140	10.500	0.418	0.750	0.0006	0.0003
8 00NF02ZM0016	13.000	12.200	195.000	1.500	13.200	0.383	0.872	0.0010	0.0007
9 00NF02ZM0016	7.800	6.280	58.500	0.840	5.200	0.144	0.420	0.0002	0.0005
10 00NF02ZM0016	8.500	7.760	85.200	1.220	8.220	0.215	0.594	0.0003	L.0002
11 00NF02ZM0016		8.900	113.000	1.100	10.000	0.180	0.400	0.0002	L.0002
12 00NF02ZM0016	8.500	8.670	107.000	1.290	10.600	0.176	0.397		
13 00NF02ZM0016	9.500	8.740	104.000	1.360	10.480	0.225	0.428	0.0003	L.0002
14 00NF02ZM0016	9.400	8.810	111.000	1.460	11.800	0.218	0.217	0.0004	0.0006
15 00NF02ZM0016	9.700	9.850	106.000	1.300	10.800	0.213	0.282	0.0005	0.0007
16 00NF02ZM0016	10.300	9.740	91.800	1.590	10.800	0.234	0.925	0.0006	0.0015
17 00NF02ZM0016	10.000	8.990	61.100	1.070	5.810	0.186	0.483	0.0003	0.0003
18 00NF02ZM0016	11.200	11.000	127.000	1.490	8.850	0.260	0.501	0.0004	0.0004
19 00NF02ZM0016	16.600	17.000	261.000	1.690	14.700	0.525	0.530	0.0007	0.0009
20 00NF02ZM0016	8.900	9.460	96.600	0.960	7.150	0.210	0.519	0.0004	0.0005
21 00NF02ZM0016	11.200	10.900	147.000	1.110	9.430	0.293	0.451	0.0008	L.0002
22 00NF02ZM0016	11.200	10.900	141.000	1.090	9.320	0.290	0.458	0.0009	0.0005
23 00NF02ZM0016	11.100	10.600	143.000	1.090	9.150	0.288	0.463	0.0005	L.0002
24 00NF02ZM0016	9.800	9.430	110.000	1.080	7.950	0.191	0.414	0.0004	0.0005
25 00NF02ZM0016	10.100	9.180	117.000	1.320	11.400	0.251	0.617	0.0004	0.0004
26 00NF02ZM0016	8.300	8.040	92.400	1.040	8.730	0.179	0.466	0.0002	0.0002
27 00NF02ZM0016	8.200	7.720	90.400	1.010	8.620	0.267	0.729	0.0002	L.0002
28 00NF02ZM0016	7.500	8.550	110.000	1.330	10.700	0.151	0.538	0.0001	L.0002
29 00NF02ZM0016	8.200	8.030	98.300	1.300	8.760	0.193	0.577	0.0003	0.0003
30 00NF02ZM0016	7.500	7.960	77.200	1.240	7.260	0.219	0.501	0.0003	0.0005
31 00NF02ZM0016	8.900	8.340	67.700	1.210	6.690	0.188	0.521	0.0004	0.0006
32 00NF02ZM0016	9.400	9.560	95.800	1.050	7.920	0.248	0.428	0.0004	0.0006
33 00NF02ZM0016	31.800	32.700	824.000	14.700	20.800	0.326	0.564	0.0006	L.0002
34 00NF02ZM0016	29.200	30.700	571.000	2.570	20.500	0.441	0.786	0.0008	0.0006
35 00NF02ZM0016	18.500	19.800	923.000	3.890	17.100	0.432	1.270	0.0009	0.0006
36 00NF02ZM0016	12.300	12.400	197.000	2.070	11.300	0.391	0.469	0.0007	0.0003
37 00NF02ZM0016	8.000	7.980	111.000	1.230	8.310	0.257	0.533	0.0006	0.0006
38 00NF02ZM0016	8.300	9.080	139.000	1.340	11.400	0.282	0.486	0.0004	0.0002
39 00NF02ZM0016	8.940	8.810	148.000	1.370	13.000	0.222	0.527	0.0003	L.0002
40 00NF02ZM0016	8.400	7.920	152.000	1.490	14.100	0.235	0.385	0.0002	L.0002
41 00NF02ZM0016	8.700	8.820	147.000	1.550	13.900	0.200	0.421	0.0003	L.0002
42 00NF02ZM0016	8.600	8.060	117.000	1.440	10.310	0.225	0.421	0.0004	0.0007
43 00NF02ZM0016	8.100	8.660	111.000	1.330	9.860	0.241	0.356	0.0003	L.0002
44 00NF02ZM0016	8.100	8.360	111.000	1.340	9.970	0.240	0.361	0.0003	L.0002

TABLE 18

LONGTERM SURFACE WATER QUALITY DATA FOR RENNIES RIVER STATION NF02ZM0016, ABOVE THE INLET TO QUIDI VIDI LAKE

1986 - 1990

STATION	EXTRBLE COPPER MG/L	EXTRBLE ZINC MG/L	EXTRBLE CADMIUM MG/L	EXTRBLE MERCURY UG/L	EXTRBLE LEAD MG/L
1 00NF02ZM0016	0.002	0.016	0.0001	L.02	0.0015
2 00NF02ZM0016	0.005	0.037	0.0002	L.02	0.0101
3 00NF02ZM0016	0.004	0.032	0.0001	L.02	0.0038
4 00NF02ZM0016	0.004	0.032	0.0001	L.02	0.0026
5 00NF02ZM0016	0.004	0.036	0.0001	L.02	0.0016
6 00NF02ZM0016	0.004	0.033	0.0002	L.02	0.0028
7 00NF02ZM0016	0.003	0.029	0.0001	L.02	0.0032
8 00NF02ZM0016	0.004	0.053	0.0004	L.02	0.0082
9 00NF02ZM0016	0.002	0.017	L.0001	L.02	0.0012
10 00NF02ZM0016	0.004	0.014	L.0001	L.02	0.0010
11 00NF02ZM0016	0.016	0.010	L.0001	L.02	0.0016
12 00NF02ZM0016	0.007	0.008	L.0001	L.02	0.0020
13 00NF02ZM0016	0.003	0.013	L.0001	L.02	0.0005
14 00NF02ZM0016	0.007	0.013	0.0002	L.02	0.0019
15 00NF02ZM0016	0.006	0.011	L.0001	L.02	0.0012
16 00NF02ZM0016	0.007	0.029	0.0010	L.01	0.0065
17 00NF02ZM0016	0.003	0.030	0.0002	L.01	0.0020
18 00NF02ZM0016	0.003	0.025	0.0002	L.01	0.0026
19 00NF02ZM0016	0.006	0.074	0.0004	L.01	0.0046
20 00NF02ZM0016	0.003	0.035	0.0003	L.01	0.0014
21 00NF02ZM0016	0.003	0.032	0.0001	0.010	0.0018
22 00NF02ZM0016	0.003	0.031	0.0002	0.010	0.0004
23 00NF02ZM0016	0.003	0.032	0.0001	0.010	0.0014
24 00NF02ZM0016	0.002	0.019	0.0002	0.010	0.0012
25 00NF02ZM0016	0.004	0.015	0.0002	0.010	0.0028
26 00NF02ZM0016	0.004	0.012	L.0001	L.01	0.0004
27 00NF02ZM0016	0.003	0.012	0.0001	L.01	0.0012
28 00NF02ZM0016	0.002	0.007	L.0001	L.01	0.0011
29 00NF02ZM0016	0.003	0.011	L.0001	L.01	0.0012
30 00NF02ZM0016	0.003	0.014	0.0001	L.01	0.0008
31 00NF02ZM0016	0.003	0.019	0.0002	L.01	0.0014
32 00NF02ZM0016	0.002	0.019	0.0005	0.090	0.0017
33 00NF02ZM0016	0.013	0.047	0.0005	0.050	0.0026
34 00NF02ZM0016	0.004	0.048	0.0007	0.030	0.0038
35 00NF02ZM0016	0.008	0.074	0.0002	0.030	0.0113
36 00NF02ZM0016	0.002	0.035	0.0002	0.010	0.0013
37 00NF02ZM0016	0.002	0.021	0.0002	0.050	0.0017
38 00NF02ZM0016	0.003	0.023	0.0001	0.030	0.0003
39 00NF02ZM0016	0.003	0.015	L.0001	L.01	0.0008
40 00NF02ZM0016	0.002	0.013	0.0001	L.01	L.002
41 00NF02ZM0016	0.003	0.011	0.0002	L.01	0.0003
42 00NF02ZM0016	0.003	0.015	L.0001	L.01	0.0008
43 00NF02ZM0016	0.002	0.013	0.0002	L.01	L.002
44 00NF02ZM0016	0.002	0.013	0.0001	L.01	L.002

TABLE 18

LONGTERM SURFACE WATER QUALITY DATA FOR RENNIES RIVER STATION

NF02ZM0016, ABOVE THE INLET TO QUIDI VIDI LAKE

1986 - 1990

STATION	SAMPLE DATE	APPAR COLOUR REL UNIT	SP COND LAB USIE/CM	SP COND FIELD USIE/CM	TEMP FIELD DEG.C.	TURBID JTU	DISS OR CARBON MG/L	DISS NITRO NO3,NO2 MG/L	TOTAL NITRO MG/L
45 00NF02ZM0016	06-NOV-89	5.000	424.000	403.000	7.200	0.540	3.000	0.370	0.528
46 00NF02ZM0016	05-DEC-89	20.000	333.000	356.000	1.600	2.800	4.200	0.500	0.653
47 00NF02ZM0016	08-JAN-90	10.000	1623.000	1574.000	1.500	1.000	2.300	0.400	0.909
48 00NF02ZM0016	12-FEB-90	30.000	515.000	521.000	1.300	0.980	3.000	0.360	0.628
49 00NF02ZM0016	06-MAR-90	20.000	492.000	480.000	1.400	1.100	2.700	0.860	0.683
50 00NF02ZM0016	03-APR-90	5.000	760.000	758.000	4.600	0.380	2.100	0.590	0.753
51 00NF02ZM0016	06-JUN-90	20.000	417.000	419.000	14.500	0.900	3.200	0.570	0.656
52 00NF02ZM0016	06-JUN-90	10.000	415.000	419.000	14.500	0.970	2.900	0.660	0.608
53 00NF02ZM0016	06-JUN-90	20.000	416.000	419.000	14.500	0.990	3.000	0.550	0.683
54 00NF02ZM0016	04-JUL-90	20.000	492.000	485.000	17.400	0.840	3.100	0.360	0.779
55 00NF02ZM0016	14-AUG-90	20.000	630.000	623.000	20.300	0.950	2.300	0.910	1.037
56 MAXIMUM		30.000	3850.000	2000.000	20.900	3.200	4.300	0.910	1.398
57 MINIMUM		5.000	241.200	271.000	0.500	0.000	1.500	0.037	0.130
58 MEAN		10.273	612.544	587.259	8.591	0.744	2.675	0.393	0.615
59 MEDIAN		10.000	418.000	428.500	7.200	0.630	2.700	0.378	0.575
60 COUNT		55.000	55.000	54.000	54.000	55.000	55.000	55.000	54.000

STATION	DISS OXYGEN MG/L	TOTAL ALKALIN MG/L	PH LAB PH UNITS	PH FIELD PH UNITS	DISS SODIUM MG/L	DISS MAGNESIUM MG/L	EXTRBLE ALUMINUM MG/L	SILICA REACTIVE MG/L	TOTAL PHOSPH MG/L
45 00NF02ZM0016	12.400	7.400	7.400	6.590	64.500	1.970	0.037	3.300	0.017
46 00NF02ZM0016	14.000	3.300	6.600	6.290	52.500	1.410	0.217	3.680	0.022
47 00NF02ZM0016	13.700	8.200	6.900	6.310	296.000	2.400	0.130	4.650	0.030
48 00NF02ZM0016	14.000	3.900		6.420	84.700	1.560	0.139	3.310	0.017
49 00NF02ZM0016	13.800	5.800	6.800	6.540	79.400	1.550	0.122	3.020	0.014
50 00NF02ZM0016	12.200	8.100	6.900	6.820	123.000	2.500	0.058	3.530	0.020
51 00NF02ZM0016	10.200	5.200	7.100	6.200	66.800	1.610	0.202	1.850	0.025
52 00NF02ZM0016	10.200	5.000	7.100	6.270	66.100	1.600	0.209	1.850	0.025
53 00NF02ZM0016	10.200	5.200	7.100	6.170	66.600	1.600	0.219	1.860	0.029
54 00NF02ZM0016	9.900	10.300	7.100	6.880	76.300	1.920	0.064	2.230	0.016
55 00NF02ZM0016	8.600	13.900	7.100	7.640	94.400	2.700	0.030	2.590	0.016
56 MAXIMUM	14.300	13.900	7.800	7.640	598.000	2.700	0.680	4.650	0.049
57 MINIMUM	8.600	3.300	6.500	6.160	35.100	1.000	0.020	0.770	0.012
58 MEAN	11.670	8.160			99.955	1.762	0.110	3.005	0.022
59 MEDIAN	12.000	8.400			66.600	1.620	0.085	3.220	0.022
60 COUNT	54.000	55.000			55.000	55.000	55.000	43.000	55.000

TABLE 18
LONGTERM SURFACE WATER QUALITY DATA FOR RENNIES RIVER STATION
NF02ZM0016, ABOVE THE INLET TO QUIDI VIDI LAKE
1986 - 1990

STATION	DISS SULPHATE MG/L	DISS SULPHATE IC-MG/L	DISS CHLORIDE MG/L	DISS POTASS MG/L	DISS CALCIUM MG/L	EXTRBLE MANGANE MG/L	EXTRBLE IRON MG/L	TOTAL COBALT MG/L	TOTAL NICKEL MG/L
45 00NF02ZM0016	8.100	8.260	112.000	1.330	9.960	0.241	0.348	0.0003	0.0002
46 00NF02ZM0016	9.600	9.190	86.100	1.350	6.320	0.293	0.552	0.0006	0.0006
47 00NF02ZM0016	16.000	15.900	490.000	4.420	15.300	0.378	0.787	0.0009	L.0002
48 00NF02ZM0016	10.200	11.000	137.000	1.400	8.490	0.360	0.428	0.0007	0.0008
49 00NF02ZM0016	8.800	10.100	133.000	1.300	8.990	0.297	0.609	0.0006	0.0005
50 00NF02ZM0016	16.400	13.900	216.000	1.710	14.900	0.480	0.492	0.0008	L.0002
51 00NF02ZM0016	9.600	8.460	113.000	1.300	8.570	0.269	0.735	0.0006	0.0003
52 00NF02ZM0016	8.900	9.040	112.000	1.260	8.490	0.267	0.762	0.0006	0.0004
53 00NF02ZM0016	9.000	9.100	114.000	1.260	8.520	0.271	0.722	0.0007	0.0004
54 00NF02ZM0016	9.400	9.640	132.000	1.250	10.900	0.228	0.484	0.0003	L.0002
55 00NF02ZM0016	9.200	10.300	174.000	1.690	15.200	0.236	0.427	0.0003	L.0002
56 MAXIMUM	31.800	32.700	923.000	14.700	20.800	0.525	1.440	0.0010	0.0015
57 MINIMUM	7.500	6.280	58.500	0.840	5.200	0.033	0.217	L.0001	L.0002
58 MEAN	10.871	10.656	163.493	1.649	10.361	0.261	0.559	0.0005	0.0004
59 MEDIAN	9.450	9.180	112.000	1.300	9.910	0.240	0.501	0.0004	0.0004
60 COUNT	54.000	55.000	55.000	55.000	54.000	55.000	55.000	54.0000	54.0000

STATION	EXTRBLE COPPER MG/L	EXTRBLE ZINC MG/L	EXTRBLE CADMIUM MG/L	EXTRBLE MERCURY UG/L	EXTRBLE LEAD MG/L
45 00NF02ZM0016	0.002	0.013	0.0002	L.01	L.002
46 00NF02ZM0016	0.003	0.046	0.0006	0.030	0.0021
47 00NF02ZM0016	0.004	0.043	0.0002	L.01	0.0032
48 00NF02ZM0016	0.002	0.039	0.0002	L.01	0.0017
49 00NF02ZM0016	0.003	0.029	0.0001	0.010	0.0007
50 00NF02ZM0016	0.002	0.033	0.0001	L.01	L.002
51 00NF02ZM0016	0.003	0.022	0.0001	L.01	0.0014
52 00NF02ZM0016	0.003	0.022	0.0001	L.01	0.0005
53 00NF02ZM0016	0.004	0.022	L.0001	L.01	0.0017
54 00NF02ZM0016	0.002	0.012	L.0001	0.010	L.002
55 00NF02ZM0016	0.003	0.010	0.0001	L.01	0.0003
56 MAXIMUM	0.016	0.074	0.0010	0.090	0.0113
57 MINIMUM	0.002	0.007	L.0001	L.01	L.002
58 MEAN	0.004	0.025	0.0000	0.017	0.0020
59 MEDIAN	0.003	0.022	0.0000	0.010	0.0014
60 COUNT	55.000	55.000	55.0000	55.000	55.0000

TABLE 19
LONGTERM SURFACE WATER QUALITY DATA FOR VIRGINIA RIVER STATION
NF02ZM0014 ABOVE THE INLET TO QUIDI VIDI LAKE
1986 - 1990

STATION	SAMPLE DATE	APPAR COLOUR REL UNIT	SP COND LAB USIE/CM	SP COND FIELD USIE/CM	TEMP FIELD DEG.C.	TURBID JTU	DISS OR CARBON MG/L	DISS NITRO NO3,NO2 MG/L	TOTAL NITRO MG/L
1 00NF02ZM0014	17-OCT-86	5.000	354.700	358.000	9.400	0.180	2.800	0.006	0.138
2 00NF02ZM0014	17-OCT-86	5.000	360.000	358.000	9.400	0.150	2.900	0.161	0.168
3 00NF02ZM0014	17-OCT-86	5.000	365.400	358.000	9.400	0.190	2.800	0.164	0.169
4 00NF02ZM0014	28-NOV-86	10.000	327.600	349.000	3.200	0.780	3.400	0.520	0.619
5 00NF02ZM0014	23-DEC-86	5.000	386.500	434.000	1.500	0.150	2.400	0.803	0.579
6 00NF02ZM0014	29-JAN-87	10.000	727.500	689.000	0.900	0.290	2.100	0.644	0.742
7 00NF02ZM0014	23-FEB-87	5.000	664.300	636.000	0.100	0.370	2.200	0.494	0.695
8 00NF02ZM0014	27-MAR-87	10.000	828.700	1042.000	3.200	0.730	2.500	0.664	0.813
9 00NF02ZM0014	24-APR-87	20.000	292.700	352.000	4.500	0.460	4.200	0.362	0.447
10 00NF02ZM0014	20-MAY-87	10.000	408.000	459.000	5.900	0.330	3.100	0.460	0.692
11 00NF02ZM0014	11-JUN-87	5.000	436.100	454.000	12.700	0.220	2.700	0.367	0.494
12 00NF02ZM0014	11-JUN-87	5.000	431.000	454.000	12.700	0.600	3.000	0.250	0.340
13 00NF02ZM0014	09-JUL-87	5.000	475.000	468.000	20.500	0.530	3.400	0.581	0.761
14 00NF02ZM0014	22-SEP-87	5.000	533.000	551.0	11.200	0.120	2.700	0.586	0.827
15 00NF02ZM0014	22-OCT-87	5.000	481.000	505.000	12.400	0.900	3.000	0.675	0.790
16 00NF02ZM0014	23-NOV-87	10.000	444.000	502.000	7.100	0.560	3.500	0.508	0.607
17 00NF02ZM0014	22-DEC-87	10.000	467.000	549.000	1.500	0.560	3.200	0.725	1.041
18 00NF02ZM0014	27-JAN-88	10.000	914.000	993.000	2.300	0.940	3.000	0.652	0.905
19 00NF02ZM0014	27-JAN-88	10.000	918.000	1004.000	2.300	1.200	3.200	0.666	0.923
20 00NF02ZM0014	27-JAN-88	10.000	927.000	1013.000	2.200	0.970	3.200	0.638	0.909
21 00NF02ZM0014	24-FEB-88	10.000	481.000	548.000	2.300	4.300	2.500	0.605	0.584
22 00NF02ZM0014	28-MAR-88	10.000	494.000	612.000	4.500	0.690	2.700	0.420	0.585
23 00NF02ZM0014	29-APR-88	10.000	521.000			0.500	2.800	0.420	0.567
24 00NF02ZM0014	30-MAY-88	5.000	552.000	576.000	9.200	0.190	2.600	0.600	1.212
25 00NF02ZM0014	21-JUN-88	5.000	466.000	490.000	14.000	0.260	3.700	0.470	0.771
26 00NF02ZM0014	15-JUL-88	10.000	475.500	388.000	14.800	0.390	4.600	0.670	1.031
27 00NF02ZM0014	10-AUG-88	5.000	492.000	477.000	19.600	0.180	3.700	0.440	
28 00NF02ZM0014	08-SEP-88	5.000	528.000	542.000	13.200	0.200	3.500	0.580	0.660
29 00NF02ZM0014	11-OCT-88	10.000	388.000	415.000	9.100	0.210	3.900	0.510	0.701
30 00NF02ZM0014	10-NOV-88	10.000	405.000	408.000	8.400	0.480	4.100	0.630	0.977
31 00NF02ZM0014	13-DEC-88	5.000	522.000	580.000	1.200	0.000	2.800	0.810	1.114
32 00NF02ZM0014	05-JAN-89	10.000	3734.000	2000.000	1.900	0.330	2.200	0.580	0.873
33 00NF02ZM0014	07-FEB-89	5.000	862.000	1014.000	1.400	0.450	2.000	0.830	1.030
34 00NF02ZM0014	06-MAR-89	5.000	1410.000	1324.000	3.100	0.900	2.100	0.740	1.282
35 00NF02ZM0014	10-APR-89	10.000	624.000	650.000	5.500	0.400	2.800	0.520	0.631
36 00NF02ZM0014	04-MAY-89	10.000	583.000	614.000	12.500	0.500	3.500	0.230	0.453
37 00NF02ZM0014	05-JUN-89	5.000	613.000	572.000	11.200	0.500	3.200	0.480	0.549
38 00NF02ZM0014	06-JUL-89	5.000	755.000	765.000	15.100	0.500	2.400	0.770	0.808
39 00NF02ZM0014	04-AUG-89	5.000	724.000	713.000	16.200	0.170	3.300	0.800	0.955
40 00NF02ZM0014	08-SEP-89	5.000	758.000	798.000	14.400	0.190	3.300	1.150	0.985
41 00NF02ZM0014	08-SEP-89	5.000	758.000	798.000	14.400	0.180	3.100	1.050	1.009
42 00NF02ZM0014	08-SEP-89	5.000	760.000	798.000	14.400	0.150	3.200	1.070	1.073
43 00NF02ZM0014	05-OCT-89	5.000	830.000	851.000	12.200	0.510	3.300	0.520	0.764
44 00NF02ZM0014	06-NOV-89	5.000	525.000	511.000	6.600	0.570	3.400	0.660	0.746

TABLE 19
LONGTERM SURFACE WATER QUALITY DATA FOR VIRGINIA RIVER STATION
NF02ZM0014 ABOVE THE INLET TO QUIDI VIDI LAKE
1986 - 1990

STATION	DISS OXYGEN MG/L	TOTAL ALKALIN MG/L	PH LAB PH UNITS	PH FIELD PH UNITS	DISS SODIUM MG/L	DISS MAGNESIUM MG/L	EXTRBLE ALUMINUM MG/L	SILICA REACTIVE MG/L	TOTAL PHOSPH MG/L
1 00NF02ZM0014	11.800	14.500	7.300	6.520	50.100	2.700	0.032		0.021
2 00NF02ZM0014	11.800	14.100	7.000	6.420	49.800	2.700	0.039		0.021
3 00NF02ZM0014	11.800	14.100	7.300	6.470	51.100	2.700	0.035		0.020
4 00NF02ZM0014	13.000	9.100	7.100	6.700	48.700	2.020	0.136		0.027
5 00NF02ZM0014	13.800	11.300	7.100	6.800	55.600	2.600	0.073		0.027
6 00NF02ZM0014	14.100	11.100	7.200	7.080	105.000	3.100	0.068		0.025
7 00NF02ZM0014	13.900	12.300	7.200	7.190	97.700	3.900	0.060		0.021
8 00NF02ZM0014	13.200	8.900	7.000	6.760	130.000	3.800	0.159		0.023
9 00NF02ZM0014	13.200	6.500	7.000	6.730	40.400	1.800	0.114		0.024
10 00NF02ZM0014	13.200	10.300	7.100	6.870	58.800	2.700	0.065		0.012
11 00NF02ZM0014	11.600	12.300	7.900	7.100	61.900	2.900	0.043		0.026
12 00NF02ZM0014	11.600	11.700	7.900	6.700	60.000	3.000	0.038	1.410	0.028
13 00NF02ZM0014	9.100	14.500	7.500	6.990	69.000	3.300	0.039		0.029
14 00NF02ZM0014	10.900	17.700	7.570	6.750	76.700	3.640	0.022	4.740	0.022
15 00NF02ZM0014	11.500	15.700	7.600	6.710	68.700	3.380	0.046	3.380	0.027
16 00NF02ZM0014	12.100	13.900	7.100	6.340	68.500	2.480	0.161	3.430	0.030
17 00NF02ZM0014	13.700	11.100	7.100	6.790	75.000	2.700	0.060	4.750	0.018
18 00NF02ZM0014	13.900	12.300	7.200	6.900	141.000	4.100	0.112	4.820	0.032
19 00NF02ZM0014	13.900	12.400	7.200	6.910	142.000	4.000	0.117	4.850	0.028
20 00NF02ZM0014	13.900	12.600	7.100	6.950	147.000	4.000	0.113	4.800	0.030
21 00NF02ZM0014	15.000	7.500	6.800	6.450	76.600	2.150	0.458	3.650	0.055
22 00NF02ZM0014	12.900	7.600	7.100	6.830	76.300	2.830	0.094	3.800	0.021
23 00NF02ZM0014		8.200	7.150	6.860	84.400	2.700	0.072	2.190	0.012
24 00NF02ZM0014	11.600	11.600	7.400	6.850	81.800	3.720	0.048	2.660	0.019
25 00NF02ZM0014	10.300	12.800	7.500	6.950	69.100	3.030	0.047	3.110	0.028
26 00NF02ZM0014	10.530	16.800	7.680	6.900	70.700	3.400	0.028	3.730	0.025
27 00NF02ZM0014	9.600	16.300	8.000	6.720	78.900	3.400	0.021	3.710	0.023
28 00NF02ZM0014	10.500	19.200	7.600	6.740	84.600	3.810	0.019	4.520	0.020
29 00NF02ZM0014	11.700	13.000	7.400	6.610	59.200	2.700	0.035	4.250	0.023
30 00NF02ZM0014	11.600	13.500	7.200	7.000	62.600	2.320	0.091	4.920	0.025
31 00NF02ZM0014	13.900	12.700	7.200	6.800	79.700	2.780	0.059	5.450	0.022
32 00NF02ZM0014	14.000	8.800	7.000	6.720	692.000	4.700	0.389	3.900	0.042
33 00NF02ZM0014	13.500	12.600	7.100	6.670	141.000	4.100	0.049	5.670	0.022
34 00NF02ZM0014	13.200	9.600	7.000	6.310	173.000	4.100	0.107	5.370	0.028
35 00NF02ZM0014	12.700	7.100	6.900	6.440	99.500	2.670	0.137	3.890	0.019
36 00NF02ZM0014	11.300	7.600	7.300	6.470	89.600	3.250	0.096	1.350	0.033
37 00NF02ZM0014	10.700	11.700	7.200	6.830	93.200	3.850	0.045	2.310	0.024
38 00NF02ZM0014	10.300	12.600	7.800	7.540	113.000	4.540	0.029	4.030	0.017
39 00NF02ZM0014	10.700	16.800	7.900	7.430	108.000	4.560	0.015	4.420	0.021
40 00NF02ZM0014	10.800	16.500	7.800	7.430	114.000	5.100	0.012	4.580	0.022
41 00NF02ZM0014	10.800	16.900	7.800	7.460	114.000	5.100	0.013	4.580	0.022
42 00NF02ZM0014	10.800	16.400	7.800	7.510	114.000	5.100	0.013	4.580	0.023
43 00NF02ZM0014	11.200	17.300	7.700	6.650	133.000	3.700	0.096	4.580	0.031
44 00NF02ZM0014	12.600	13.200	7.700	6.890	78.300	3.600	0.044	4.630	0.026

TABLE 19
LONGTERM SURFACE WATER QUALITY DATA FOR VIRGINIA RIVER STATION
NF02ZM0014 ABOVE THE INLET TO QUIDI VIDI LAKE
1986 - 1990

STATION	DISS SULPHATE MG/L	DISS SULPHATE IC-MG/L	DISS CHLORIDE MG/L	DISS POTASS MG/L	DISS CALCIUM MG/L	EXTRBLE MANGANE MG/L	EXTRBLE IRON MG/L	TOTAL COBALT MG/L	TOTAL NICKEL MG/L
1 00NF02ZM0014	11.900	12.350	86.400	1.360	10.400	0.017	0.094	0.0005	L.0002
2 00NF02ZM0014	12.400	12.300	87.300	1.350	10.600	0.019	0.097	0.0005	L.0002
3 00NF02ZM0014	12.700	12.470	89.300	1.360	10.700	0.018	0.101	0.0005	L.0002
4 00NF02ZM0014	13.100	12.170	78.750	1.220	8.070	0.075	0.175	0.0003	0.0005
5 00NF02ZM0014	12.900	12.510	91.700	1.290	10.300	0.116	0.137	0.0005	0.0006
6 00NF02ZM0014	14.300	13.400	186.000	1.470	13.600	0.173	0.117	0.0015	0.0028
7 00NF02ZM0014	13.600	13.900	168.000	1.530	16.900	0.271	0.142	0.0008	0.0015
8 00NF02ZM0014	14.500	15.400	226.000	1.830	18.200	0.294	0.197	0.0012	0.0009
9 00NF02ZM0014	9.500	8.240	71.100	1.020	7.000	0.360	0.210	0.0004	0.0003
10 00NF02ZM0014	11.400	11.100	101.000	1.240	11.000	0.083	0.136	0.0002	L.0002
11 00NF02ZM0014	10.700	11.600	109.000	1.290	12.000	0.031	0.098	0.0001	L.0002
12 00NF02ZM0014		10.100	114.000	1.100	12.000	0.040	0.100		
13 00NF02ZM0014	13.100	12.300	116.000	1.400	13.400	0.033	0.105	0.0002	L.0002
14 00NF02ZM0014	14.000	14.500	137.000	1.540	15.700	0.016	0.059	0.0003	0.0004
15 00NF02ZM0014	13.700	13.700	115.000	1.550	14.300	0.024	0.073	0.0004	0.0006
16 00NF02ZM0014	14.200	14.300	105.000	1.460	10.100	0.062	0.284	0.0003	0.0006
17 00NF02ZM0014	14.400	14.300	115.000	1.280	10.800	0.109	0.105	0.0003	0.0004
18 00NF02ZM0014	16.900	16.600	241.000	1.860	19.500	0.216	0.247	0.0007	0.0004
19 00NF02ZM0014	17.100	17.700	238.000	1.870	19.100	0.216	0.252	0.0008	0.0004
20 00NF02ZM0014	17.100	17.700	248.000	1.880	18.900	0.217	0.253	0.0007	0.0008
21 00NF02ZM0014	12.900	14.800	125.000	1.450	9.920	0.157	0.741	0.0007	0.0007
22 00NF02ZM0014	11.600	11.800	124.000	1.280	11.400	0.109	0.143	0.0004	L.0002
23 00NF02ZM0014	12.600	12.500	138.000	1.320	11.500	0.089	0.095	0.0004	0.0005
24 00NF02ZM0014	13.500	13.040	145.000	1.360	14.400	0.035	0.091	0.0002	0.0005
25 00NF02ZM0014	11.800	11.900	120.000	1.240	12.300	0.045	0.124	0.0002	L.0002
26 00NF02ZM0014	11.700	12.300	121.000	1.260	13.200	0.025	0.120	0.0002	L.0002
27 00NF02ZM0014	10.900	12.400	128.000	1.490	13.800	0.013	0.049	0.0001	L.0002
28 00NF02ZM0014	12.500	13.000	138.000	1.500	15.000	0.016	0.047	0.0001	L.0002
29 00NF02ZM0014	10.900	11.600	97.100	1.390	10.600	0.023	0.126	0.0001	0.0003
30 00NF02ZM0014	12.800	13.500	102.000	1.490	9.360	0.060	0.193	0.0003	0.0005
31 00NF02ZM0014	14.600	15.700	131.000	1.280	11.200	0.098	0.125	0.0004	0.0004
32 00NF02ZM0014	56.100	58.100	1070.000	15.700	32.800	0.219	0.753	0.0008	L.0002
33 00NF02ZM0014	18.500	18.100	242.000	2.030	19.100	0.250	0.112	0.0005	0.0003
34 00NF02ZM0014	17.900	17.500	298.000	2.420	20.000	0.294	0.209	0.0007	0.0008
35 00NF02ZM0014	12.300	12.400	170.000	1.610	13.400	0.389	0.149	0.0008	0.0007
36 00NF02ZM0014	11.800	11.800	154.000	1.690	13.400	0.100	0.164	0.0003	0.0003
37 00NF02ZM0014	12.000	12.200	167.000	1.610	16.200	0.055	0.120	0.0002	0.0002
38 00NF02ZM0014	14.500	14.700	204.000	1.840	20.900	0.036	0.071	0.0003	L.0002
39 00NF02ZM0014	13.600	13.400	199.000	1.830	20.700	0.017	0.047	0.0001	L.0002
40 00NF02ZM0014	14.800	15.300	207.000	2.020	21.700	0.016	0.032	0.0003	L.0002
41 00NF02ZM0014	15.000	15.200	207.000	2.030	21.600	0.018	0.034	0.0001	L.0002
42 00NF02ZM0014	15.100	15.200	206.000	2.030	21.500	0.017	0.032	0.0003	L.0002
43 00NF02ZM0014	13.400	13.800	223.000	3.570	17.100	0.063	0.210	0.0006	0.0008
44 00NF02ZM0014	13.100	14.300	137.000	1.840	15.000	0.040	0.094	0.0002	L.0002

TABLE 19
LONGTERM SURFACE WATER QUALITY DATA FOR VIRGINIA RIVER STATION
NF02ZM0014 ABOVE THE INLET TO QUIDI VIDI LAKE
1986 - 1990

STATION	EXTRBLE COPPER MG/L	EXTRBLE ZINC MG/L	EXTRBLE CADMIUM MG/L	EXTRBLE MERCURY UG/L	EXTRBLE LEAD MG/L
1 00NF02ZM0014	0.0013	0.0250	L.0001	L.02	0.0003
2 00NF02ZM0014	0.0014	0.0249	L.0001	L.02	0.0006
3 00NF02ZM0014	0.0014	0.0236	L.0001	L.02	0.0007
4 00NF02ZM0014	0.0019	0.0418	L.0001	L.02	0.0013
5 00NF02ZM0014	0.0034	0.0448	L.0001	L.02	0.0007
6 00NF02ZM0014	0.0036	0.0458	0.0005	L.02	0.0061
7 00NF02ZM0014	0.0019	0.0552	0.0002	L.02	0.0021
8 00NF02ZM0014	0.0034	0.0773	0.0002	L.02	0.0032
9 00NF02ZM0014	0.0018	0.0273	L.0001	L.02	0.0005
10 00NF02ZM0014	0.0021	0.0260	L.0001	L.02	0.0010
11 00NF02ZM0014	0.0042	0.0122	L.0001	L.02	0.0009
12 00NF02ZM0014	0.0140	0.0100	0.0010	L.02	0.0020
13 00NF02ZM0014	0.0063	0.0241	L.0001	L.02	L.0002
14 00NF02ZM0014	0.0044	0.0232	L.0001	L.02	0.0007
15 00NF02ZM0014	0.0021	0.0186	0.0002	L.01	0.0013
16 00NF02ZM0014	0.0025	0.0364	L.0001	L.01	0.0023
17 00NF02ZM0014	0.0022	0.0344	L.0001	L.01	0.0011
18 00NF02ZM0014	0.0037	0.0828	0.0002	L.01	0.0024
19 00NF02ZM0014	0.0025	0.0830	0.0002	L.01	0.0030
20 00NF02ZM0014	0.0049	0.0827	0.0003	L.01	0.0032
21 00NF02ZM0014	0.0063	0.0697	0.0003	L.01	0.0079
22 00NF02ZM0014	0.0019	0.0439	0.0001	0.020	0.0007
23 00NF02ZM0014	0.0015	0.0299	L.0001	0.030	0.0004
24 00NF02ZM0014	0.0015	0.0238	L.0001	0.020	0.0002
25 00NF02ZM0014	0.0023	0.0216	L.0001	0.020	L.0002
26 00NF02ZM0014	0.0036	0.0145	L.0001	0.010	0.0003
27 00NF02ZM0014	0.0023	0.0104	L.0001	L.01	L.0002
28 00NF02ZM0014	0.0014	0.0121	L.0001	L.01	L.0002
29 00NF02ZM0014	0.0017	0.0213	L.0001	L.01	0.0002
30 00NF02ZM0014	0.0021	0.0323	0.0001	0.020	0.0012
31 00NF02ZM0014	0.0017	0.0298	L.0001	0.010	L.0002
32 00NF02ZM0014	0.0066	0.1350	0.0008	0.020	0.0059
33 00NF02ZM0014	0.0025	0.0536	L.0001	0.020	L.0002
34 00NF02ZM0014	0.0025	0.0607	0.0002	0.020	0.0014
35 00NF02ZM0014	0.0023	0.0438	0.0005	L.01	0.0007
36 00NF02ZM0014	0.0023	0.0243	L.0001	0.010	L.0002
37 00NF02ZM0014	0.0018	0.0237	0.0001	0.020	L.0002
38 00NF02ZM0014	0.0016	0.0172	L.0001	L.01	L.0002
39 00NF02ZM0014	0.0015	0.0119	L.0001	L.01	L.0002
40 00NF02ZM0014	0.0019	0.0117	L.0001	0.020	L.0002
41 00NF02ZM0014	0.0017	0.0118	L.0001	0.010	L.0002
42 00NF02ZM0014	0.0019	0.0121	L.0001	L.01	L.0002
43 00NF02ZM0014	0.0021	0.0234	0.0002	0.040	L.0002
44 00NF02ZM0014	0.0008	0.0161	L.0001	L.01	L.0002

TABLE 19

LONGTERM SURFACE WATER QUALITY DATA FOR VIRGINIA RIVER STATION

NF02ZM0014 ABOVE THE INLET TO QUIDI VIDI LAKE

1986 - 1990

STATION	SAMPLE DATE	APPAR COLOUR REL UNIT	SP COND LAB USIE/CM	SP COND FIELD USIE/CM	TEMP FIELD DEG.C.	TURBID JTU	DISS OR CARBON MG/L	DISS NITRO NO3,NO2 MG/L	TOTAL NITRO MG/L
45 00NF02ZM0014	05-DEC-89	20.000	486.000	491.000	2.800	4.900	4.100	0.970	1.091
46 00NF02ZM0014	08-JAN-90	5.000	986.000	965.000	2.200	0.650	2.700	1.040	1.267
47 00NF02ZM0014	12-FEB-90	20.000	681.000	685.000	1.800	2.400	3.200	0.640	0.884
48 00NF02ZM0014	06-MAR-90	10.000	701.000	692.000	2.100	1.500	2.700	0.640	0.850
49 00NF02ZM0014	03-APR-90	5.000	1090.000	1079.000	4.400	0.270	2.200	0.820	0.961
50 00NF02ZM0014	03-APR-90	5.000	1089.000	1079.000	4.400	0.270	2.300	0.820	0.974
51 00NF02ZM0014	03-APR-90	5.000	1091.000	1079.000	4.400	0.350	2.300	0.840	0.952
52 00NF02ZM0014	06-JUN-90	30.000	587.000	590.000	13.000	1.600	4.500	0.460	0.720
53 00NF02ZM0014	04-JUL-90	20.000	599.000	590.000	15.600	0.960	3.500	0.700	0.934
54 00NF02ZM0014	14-AUG-90	5.000	812.000	812.000	18.500	0.390	3.000	1.040	1.500
55 MAXIMUM		30.000	3734.000	2000.000	20.500	4.900	4.600	1.150	1.500
56 MINIMUM		5.000	292.700	349.000	0.100	0.000	2.000	0.006	0.138
57 MEAN		8.333	687.481	679.887	8.053	0.672	3.046	0.619	0.795
58 MEDIAN		5.000	567.500	590.000	7.100	0.455	3.000	0.634	0.808
59 COUNT		54.000	54.000	53.000	53.000	54.000	54.000	54.000	53.000

STATION	DISS OXYGEN MG/L	TOTAL ALKALIN MG/L	PH LAB PH UNITS	PH FIELD PH UNITS	DISS SODIUM MG/L	DISS MAGNESIUM MG/L	EXTRBLE ALUMINUM MG/L	SILICA REACTIVE MG/L	TOTAL PHOSPH MG/L
45 00NF02ZM0014	13.500	7.300	7.100	6.620	74.900	2.780	0.370	4.750	0.033
46 00NF02ZM0014	13.700	10.200	7.300	6.460	153.000	4.500	0.078	5.910	0.017
47 00NF02ZM0014	13.700	5.700		6.680	108.000	2.910	0.214	3.900	0.025
48 00NF02ZM0014	13.600	7.300	7.200	6.580	113.000	2.940	0.145	3.710	0.024
49 00NF02ZM0014	12.500	10.500	7.400	6.750	173.000	5.100	0.066	4.290	0.020
50 00NF02ZM0014	12.500	9.700	7.400	6.810	174.000	5.200	0.068	4.300	0.020
51 00NF02ZM0014	12.500	9.700	7.400	6.840	173.000	5.100	0.069	4.320	0.020
52 00NF02ZM0014	10.800	4.300	7.600	6.560	94.400	2.450	0.214	2.060	0.037
53 00NF02ZM0014	10.900	13.900	8.000	7.030	90.900	3.490	0.063	1.940	0.022
54 00NF02ZM0014	10.100	18.400	8.300	6.990	121.000	5.080	0.040	4.940	0.022
55 MAXIMUM	15.000	19.200	8.300	7.540	692.000	5.200	0.458	5.910	0.055
56 MINIMUM	9.100	4.300	6.800	6.310	40.400	1.800	0.012	1.350	0.012
57 MEAN	12.189	12.031			106.643	3.487	0.090	4.004	0.025
58 MEDIAN	12.100	12.300			87.100	3.390	0.064	4.295	0.023
59 COUNT	53.000	54.000			54.000	54.000	54.000	42.000	54.000

TABLE 19
LONGTERM SURFACE WATER QUALITY DATA FOR VIRGINIA RIVER STATION
NF02ZM0014 ABOVE THE INLET TO QUIDI VIDI LAKE
1986 - 1990

STATION	DISS SULPHATE MG/L	DISS SULPHATE IC-MG/L	DISS CHLORIDE MG/L	DISS POTASS MG/L	DISS CALCIUM MG/L	EXTRBLE MANGANE MG/L	EXTRBLE IRON MG/L	TOTAL COBALT MG/L	TOTAL NICKEL MG/L
45 00NF02ZM0014	14.000	14.800	123.000	2.090	10.500	0.197	0.476	0.0008	0.0010
46 00NF02ZM0014	17.700	17.700	267.000	2.560	18.900	0.252	0.138	0.0009	0.0006
47 00NF02ZM0014	15.000	14.600	185.000	2.000	13.200	0.272	0.306	0.0008	0.0011
48 00NF02ZM0014	11.900	14.200	194.000	1.820	13.800	0.229	0.219	0.0006	0.0005
49 00NF02ZM0014	18.100	18.200	315.000	2.450	24.100	0.291	0.139	0.0010	0.0007
50 00NF02ZM0014	18.300	18.000	312.000	2.460	24.200	0.291	0.137	0.0010	L.0002
51 00NF02ZM0014	16.300	18.000	313.000	2.470	24.400	0.288	0.134	0.0011	0.0011
52 00NF02ZM0014	13.300	12.600	162.000	1.660	11.300	0.101	0.351	0.0006	0.0005
53 00NF02ZM0014	13.300	15.000	160.000	1.620	14.400	0.051	0.122	0.0002	L.0002
54 00NF02ZM0014	15.500	14.800	220.000	2.060	21.200	0.023	0.046	0.0003	0.0002
55 MAXIMUM	56.100	58.100	1070.000	15.700	32.800	0.389	0.753	0.0015	0.0028
56 MINIMUM	9.500	8.240	71.100	1.020	7.000	0.013	0.032	0.0001	L.0002
57 MEAN	14.619	14.798	181.994	1.951	15.271	0.122	0.165	0.0005	0.0005
58 MEDIAN	13.500	13.850	149.500	1.580	13.800	0.079	0.126	0.0004	0.0004
59 COUNT	53.000	54.000	54.000	54.000	54.000	54.000	54.000	53.0000	53.0000

STATION	EXTRBLE COPPER MG/L	EXTRBLE ZINC MG/L	EXTRBLE CADMIUM MG/L	EXTRBLE MERCURY UG/L	EXTRBLE LEAD MG/L
45 00NF02ZM0014	0.0027	0.0686	0.0003	L.01	0.0026
46 00NF02ZM0014	0.0019	0.0531	0.0002	L.01	L.0002
47 00NF02ZM0014	0.0024	0.0653	0.0002	0.010	0.0011
48 00NF02ZM0014	0.0024	0.0536	0.0001	0.010	0.0011
49 00NF02ZM0014	0.0022	0.0461	0.0002	0.020	L.0002
50 00NF02ZM0014	0.0013	0.0461	L.0001	0.010	L.0002
51 00NF02ZM0014	0.0023	0.0452	0.0003	0.010	L.0002
52 00NF02ZM0014	0.0031	0.0311	0.0001	0.020	0.0011
53 00NF02ZM0014	0.0022	0.0128	L.0001	L.01	L.0002
54 00NF02ZM0014	0.0018	0.0061	0.0001	0.010	L.0002
55 MAXIMUM	0.0140	0.1350	0.0010	0.040	0.0079
56 MINIMUM	0.0008	0.0061	L.0001	0.010	L.0002
57 MEAN	0.0027	0.0367	0.0002	0.016	0.0012
58 MEDIAN	0.0022	0.0286	0.0001	0.015	0.0006
59 COUNT	54.0000	54.0000	54.0000	54.000	54.0000

TABLE 20
LONGTERM SURFACE WATER QUALITY DATA FOR THE OUTLET OF
QUDI VIDI LAKE NF02ZM0015 1986 - 1990

STATION	SAMPLE DATE	APPAR COLOUR REL UNIT	SP COND LAB USIE/CM	SP COND FIELD USIE/CM	TEMP FIELD DEG.C.	TURBID JTU	DISS OR CARBON MG/L	DISS NITRO NO3,NO2 MG/L	TOTAL NITRO MG/L
1 00NF02ZM0015	17-OCT-86	10.000	290.400	296.000	9.400	0.180	2.700	0.272	0.358
2 00NF02ZM0015	28-NOV-86	10.000	436.800	386.000	1.900	0.600	2.500	0.451	0.516
3 00NF02ZM0015	28-NOV-86	10.000	436.800	386.000	1.900	0.900	2.600	0.393	0.487
4 00NF02ZM0015	28-NOV-86	20.000	436.000	386.000	1.900	0.680	2.500	0.407	0.487
5 00NF02ZM0015	23-DEC-86	5.000	521.900	501.000	0.800	0.090	2.000	0.504	0.678
6 00NF02ZM0015	29-JAN-87	10.000	759.700	717.000	0.600	0.530	1.800	0.497	0.642
7 00NF02ZM0015	23-FEB-87	10.000	730.000	715.000	0.600	0.490	3.700	0.436	0.533
8 00NF02ZM0015	27-MAR-87	10.000	679.000	778.000	1.400	0.800	2.500	0.432	0.773
9 00NF02ZM0015	24-APR-87	20.000	321.200	350.000	5.800	0.660	3.700	0.293	0.431
10 00NF02ZM0015	20-MAY-87	10.000	293.000	331.000	9.600	0.320	3.200	0.243	0.426
11 00NF02ZM0015	11-JUN-87	10.000	342.000	338.000	14.000	0.210	2.900	0.230	0.405
12 00NF02ZM0015	11-JUN-87	10.000	339.000	338.000	14.000	0.700	3.000	0.180	0.240
13 00NF02ZM0015	09-JUL-87	10.000	376.000	373.000	18.700	0.480	2.900	0.257	0.390
14 00NF02ZM0015	20-AUG-87	5.000	422.000	415.000	17.000	0.350	2.500	0.259	0.641
15 00NF02ZM0015	22-SEP-87	5.000	424.000	570.000	13.400	0.130	2.400	0.316	0.562
16 00NF02ZM0015	22-OCT-87	5.000	428.000	443.000	11.300	0.900	2.400	0.339	0.601
17 00NF02ZM0015	23-NOV-87	5.000	389.000	454.000	5.700	0.280	2.800	0.448	0.589
18 00NF02ZM0015	22-DEC-87	10.000	528.000	603.000	0.800	1.100	3.100	0.473	0.744
19 00NF02ZM0015	27-JAN-88	10.000	859.000	918.000	1.400	1.300	2.500	0.505	0.911
20 00NF02ZM0015	29-FEB-88	20.000	512.000	546.000	1.400	1.900		0.435	0.521
21 00NF02ZM0015	28-MAR-88	10.000	707.000	808.000	3.500	0.970	2.100	0.410	0.606
22 00NF02ZM0015	29-APR-88	10.000	490.000	479.000	5.400	1.200	2.500	0.320	0.503
23 00NF02ZM0015	29-APR-88	10.000	489.000	525.000	5.400	0.870	2.500	0.310	0.502
24 00NF02ZM0015	29-APR-88	10.000	489.000	522.000	5.500	1.400	2.500	0.310	0.494
25 00NF02ZM0015	30-MAY-88	10.000	399.000	354.000	14.400	0.310	3.000	0.270	0.461
26 00NF02ZM0015	21-JUN-88	5.000	378.000	383.000	17.200	0.280	3.000	0.200	0.440
27 00NF02ZM0015	15-JUL-88	10.000	365.000	368.000	18.200	0.350	4.300	0.240	0.531
28 00NF02ZM0015	10-AUG-88	5.000	393.000	376.000	20.400	0.180	3.400	0.270	
29 00NF02ZM0015	13-SEP-88	5.000	406.000	410.000	17.700	0.380	3.600	0.280	0.393
30 00NF02ZM0015	11-OCT-88	5.000	389.000	360.000	11.100	0.150	3.100	0.300	0.465
31 00NF02ZM0015	10-NOV-88	10.000	340.000	359.000	8.600	5.000	3.300	0.280	0.674
32 00NF02ZM0015	13-DEC-88	5.000	423.000	468.000	0.900	0.000	3.000	0.450	0.684
33 00NF02ZM0015	05-JAN-89	5.000	802.000	880.000	0.100	1.300	2.500	0.480	0.774
34 00NF02ZM0015	08-FEB-89	5.000	859.000	981.000	0.800	0.700	1.900	0.530	0.887
35 00NF02ZM0015	06-MAR-89	5.000	1284.000	1078.000	1.100	1.000	2.200	0.450	0.925
36 00NF02ZM0015	10-APR-89	10.000	910.000	972.000	2.200	0.800	2.300	0.350	0.574
37 00NF02ZM0015	04-MAY-89	10.000	627.000	578.000	10.100	0.850	2.800	0.210	0.476
38 00NF02ZM0015	05-JUN-89	40.000	574.000	522.000	14.300	1.000	2.500	0.210	0.402
39 00NF02ZM0015	06-JUL-89	5.000	553.000	577.000	17.900	0.500	2.300	0.260	0.406
40 00NF02ZM0015	04-AUG-89	10.000	535.000	30.700	20.300	0.350	3.400	0.290	0.462
41 00NF02ZM0015	08-SEP-89	5.000	549.000	567.000	16.800	0.400	3.600	0.700	0.481
42 00NF02ZM0015	05-OCT-89	5.000	527.000	534.000	13.600	0.920	3.200	0.380	0.444
43 00NF02ZM0015	05-OCT-89	5.000	528.000	534.000	13.600	1.100	3.300	0.400	0.419
44 00NF02ZM0015	05-OCT-89	5.000	530.000	534.000	13.600	0.690	3.100	0.340	0.460
45 00NF02ZM0015	06-NOV-89	10.000	480.000	477.000	6.900	1.050	3.600	0.360	0.462

TABLE 20

LONGTERM SURFACE WATER QUALITY DATA FOR THE OUTLET OF

QUDI VIDI LAKE NF02ZM0015 1986 - 1990

STATION	DISS OXYGEN MG/L	TOTAL ALKALIN MG/L	PH LAB PH UNITS	PH FIELD PH UNITS	DISS SODIUM MG/L	DISS MAGNESIUM MG/L	EXTRBLE ALUMINUM MG/L	SILICA REACTIVE MG/L	TOTAL PHOSPH MG/L
1 00NF02ZM0015	11.000	9.300	7.000	6.650	41.400	1.790	0.046		0.012
2 00NF02ZM0015	13.100	7.400	6.900	6.650	69.600	1.630	0.146		0.022
3 00NF02ZM0015	13.100	8.000	6.900	6.640	70.100	1.620	0.148		0.023
4 00NF02ZM0015	13.100	7.300	6.900	6.640	69.600	1.620	0.155		0.021
5 00NF02ZM0015	13.000	10.000	6.800	6.490	82.200	1.850	0.124		0.021
6 00NF02ZM0015	13.100	9.200	6.800	6.890	118.000	2.100	0.062		0.019
7 00NF02ZM0015	12.500	8.600	6.700	6.940	117.000	2.200	0.072		0.017
8 00NF02ZM0015	13.300	6.100	6.600	6.480	110.000	2.000	0.180		0.018
9 00NF02ZM0015	12.000	5.200	6.700	6.620	47.700	1.300	0.148		0.017
10 00NF02ZM0015	11.300	7.000	6.900	6.540	43.200	1.420	0.093		0.012
11 00NF02ZM0015	11.300	7.900	7.500	6.800	51.400	1.700	0.035		0.014
12 00NF02ZM0015	11.300	8.000	7.500	6.800	50.000	1.700	0.043	0.100	0.013
13 00NF02ZM0015	9.400	9.700	7.200	6.620	56.000	1.950	0.216		0.025
14 00NF02ZM0015	8.100	12.900	7.100	6.930	64.970	2.300	0.038	1.470	0.012
15 00NF02ZM0015	9.400	13.100	7.240	6.720	62.300	2.330	0.030	0.350	0.011
16 00NF02ZM0015	10.500	11.800	7.200	6.860	64.900	2.290	0.014	1.010	0.010
17 00NF02ZM0015	12.100	10.100	6.900	6.720	60.700	2.010	0.097	3.030	0.016
18 00NF02ZM0015	13.300	8.900	6.800	6.680	90.400	1.720	0.109	3.870	0.015
19 00NF02ZM0015	12.200	11.000	6.600	6.740	140.000	2.700	0.066	4.380	0.019
20 00NF02ZM0015	13.100	4.600	6.600	6.330	86.300	1.600	0.241	3.210	0.022
21 00NF02ZM0015	13.000	7.500	6.800	6.760	129.000	2.070	0.135	3.450	0.017
22 00NF02ZM0015	12.400	5.700	6.800	6.630	82.800	1.660	0.124	2.090	
23 00NF02ZM0015	12.400	5.600	6.800	6.600	82.300	1.730	0.123	2.060	0.010
24 00NF02ZM0015	12.400	5.600	6.800	6.730	80.500	1.690	0.124	2.050	0.010
25 00NF02ZM0015	9.700	7.800	7.100	6.800	67.300	1.910	0.035	0.530	0.014
26 00NF02ZM0015	9.900	8.800	7.200	6.780	60.500	1.790	0.026	0.380	0.010
27 00NF02ZM0015	8.150	11.400	7.060	6.590	64.700	1.900	0.018	1.470	0.011
28 00NF02ZM0015	8.400	12.200	7.300	6.550	60.700	2.000	0.014	2.260	0.008
29 00NF02ZM0015	9.800	13.100	7.500	6.640	70.100	2.140	0.052	1.100	0.016
30 00NF02ZM0015	9.900	12.900	7.400	6.560	60.700	2.050	0.024	0.590	0.015
31 00NF02ZM0015	11.800	10.600	7.280	6.830	51.500	1.940	0.107	1.760	0.020
32 00NF02ZM0015	12.500	10.200	7.300	6.760	65.000	1.770	0.104	1.890	0.015
33 00NF02ZM0015	15.200	10.200	7.000	7.190	145.000	2.100	0.061	3.260	0.016
34 00NF02ZM0015	12.900	11.000	6.700	6.560	148.000	2.600	0.051	4.510	0.012
35 00NF02ZM0015	13.100	8.400	6.600	6.270	174.000	2.300	0.117	4.070	0.018
36 00NF02ZM0015	12.600	7.500	6.600	6.370	158.000	1.830	0.148	4.160	0.020
37 00NF02ZM0015	12.200	6.500	6.900	6.460	98.900	2.050	0.252	1.920	0.023
38 00NF02ZM0015	9.400	8.400	6.900	6.720	92.000	2.270	0.031	0.140	0.010
39 00NF02ZM0015	9.200	8.900	7.400	7.320	86.800	2.320	0.026	0.750	0.009
40 00NF02ZM0015	9.700	9.900	7.700	7.060	82.500	2.350	0.015	0.140	0.013
41 00NF02ZM0015	9.600	11.000	7.500	7.160	84.900	2.700	0.006	0.860	0.007
42 00NF02ZM0015	10.400	10.800	7.500	6.720	81.100	2.600	0.040	0.020	0.012
43 00NF02ZM0015	10.400	10.600	7.500	6.700	81.100	2.600	0.034	0.020	0.014
44 00NF02ZM0015	10.400	9.400	7.500	6.680	80.300	2.600	0.032	0.020	0.014
45 00NF02ZM0015	12.000	9.600	7.700	6.890	74.900	2.300	0.048	0.080	0.014

TABLE 20
LONGTERM SURFACE WATER QUALITY DATA FOR THE OUTLET OF
QUDI VIDI LAKE NF02ZM0015 1986 - 1990

STATION	DISS SULPHATE MG/L	DISS SULPHATE IC-MG/L	DISS CHLORIDE MG/L	DISS POTASS MG/L	DISS CALCIUM MG/L	EXTRBLE MANGANE MG/L	EXTRBLE IRON MG/L	TOTAL COBALT MG/L	TOTAL NICKEL MG/L
1 00NF02ZM0015	9.600	8.690	70.600	1.170	8.300	0.169	0.241	0.0007	L.0002
2 00NF02ZM0015	13.100	11.790	110.200	1.140	8.350	0.176	0.341	0.0003	0.0006
3 00NF02ZM0015	13.300	11.760	113.400	1.140	8.340	0.179	0.348	0.0002	0.0005
4 00NF02ZM0015	13.400	11.770	109.600	1.150	8.360	0.179	0.349	0.0003	0.0006
5 00NF02ZM0015	14.100	13.200	137.800	1.260	10.100	0.244	0.395	0.0006	0.0006
6 00NF02ZM0015	16.500	17.700	191.000	1.320	12.100	0.349	0.341	0.0004	0.0017
7 00NF02ZM0015	13.700	14.500	188.000	1.260	12.700	0.369	0.351	0.0005	0.0005
8 00NF02ZM0015	12.900	12.400	187.000	1.390	12.200	0.351	0.455	0.0008	0.0004
9 00NF02ZM0015	9.200	7.850	80.900	0.940	6.600	0.235	0.402	0.0004	0.0005
10 00NF02ZM0015	8.600	7.810	72.600	0.980	6.920	0.185	0.363	0.0004	0.0003
11 00NF02ZM0015	8.800	8.500	87.100	1.080	8.210	0.159	0.212	0.0002	L.0002
12 00NF02ZM0015		6.800	89.000	0.920	8.400	0.160	0.200		L.0002
13 00NF02ZM0015	9.900	7.040	94.100	1.280	9.670	0.323	0.680	0.0005	0.0002
14 00NF02ZM0015	9.600	9.300	106.000	1.300	11.100	0.200	0.227	0.0002	0.0003
15 00NF02ZM0015	10.500	10.500	110.000	1.420	12.000	0.199	0.234	0.0005	0.0006
16 00NF02ZM0015	10.900	21.700	106.000	1.400	11.900	0.159	0.099	0.0003	0.0007
17 00NF02ZM0015	10.600	10.900	98.800	1.350	9.210	0.154	0.284	0.0002	0.0004
18 00NF02ZM0015	13.000	11.900	131.000	1.290	8.520	0.191	0.339	0.0004	0.0005
19 00NF02ZM0015	16.800	17.000	231.000	1.770	14.200	0.389	0.293	0.0005	0.0003
20 00NF02ZM0015	11.100	12.100	135.000	1.090	8.240	0.210	0.437	0.0007	0.0008
21 00NF02ZM0015	14.000	13.500	188.000	1.220	11.500	0.267	0.420	0.0006	L.0002
22 00NF02ZM0015	11.800	11.300	129.000	1.080	8.710	0.164	0.330	0.0005	0.0005
23 00NF02ZM0015	11.500	11.500	129.000	1.080	8.800	0.169	0.342	0.0005	0.0005
24 00NF02ZM0015	11.700	11.200	130.000	1.080	8.610	0.168	0.342	0.0003	0.0005
25 00NF02ZM0015	10.700	10.040	101.000	1.070	9.130	0.203	0.186	0.0002	0.0004
26 00NF02ZM0015	9.700	9.550	97.200	1.070	8.860	0.144	0.115	L.0001	L.0002
27 00NF02ZM0015	9.200	9.270	94.000	1.020	8.970	0.177	0.239	L.0001	L.0002
28 00NF02ZM0015	7.500	9.060	104.000	1.170	9.800	0.179	0.375	0.0002	0.0004
29 00NF02ZM0015	9.100	8.940	106.000	1.290	10.200	0.107	0.861	0.0001	0.0005
30 00NF02ZM0015	8.200	8.750	101.000	1.330	9.680	0.058	0.371	0.0002	0.0003
31 00NF02ZM0015	10.300	9.990	86.700	1.430	8.550	0.111	0.253	0.0002	0.0005
32 00NF02ZM0015	11.600	11.800	105.000	1.170	8.490	0.230	0.395	0.0004	0.0006
33 00NF02ZM0015	16.800	16.600	219.000	2.180	12.400	0.264	0.252	0.0005	0.0002
34 00NF02ZM0015	16.400	16.400	243.000	2.420	14.500	0.337	0.313	0.0005	0.0007
35 00NF02ZM0015	17.800	16.500	284.000	2.780	14.600	0.371	0.439	0.0006	0.0005
36 00NF02ZM0015	14.400	14.100	246.000	2.530	12.500	0.541	0.598	0.0008	0.0006
37 00NF02ZM0015	10.900	10.800	164.000	1.670	11.400	0.345	0.637	0.0005	0.0003
38 00NF02ZM0015	10.400	10.400	159.000	1.540	12.300	0.307	0.237	0.0003	0.0008
39 00NF02ZM0015	9.870	10.000	151.000	1.470	12.400	0.196	0.139	0.0003	L.0002
40 00NF02ZM0015	8.900	8.500	144.000	1.430	13.100	0.210	0.465	0.0003	0.0003
41 00NF02ZM0015	9.700	9.710	146.000	1.520	13.500	0.146	0.131	0.0002	L.0002
42 00NF02ZM0015	9.700	9.620	139.000	1.550	13.400	0.105	0.211	0.0004	0.0008
43 00NF02ZM0015	9.700	9.860	143.000	1.580	13.200	0.109	0.209	0.0002	0.0004
44 00NF02ZM0015	9.900	9.610	138.000	1.570	13.500	0.111	0.206	0.0002	0.0005
45 00NF02ZM0015	9.300	10.600	128.000	1.650	12.100	0.135	0.194	0.0002	0.0003

TABLE 20

LONGTERM SURFACE WATER QUALITY DATA FOR THE OUTLET OF QUDI VIDI LAKE NF02ZM0015 1986 - 1990

STATION	EXTRBLE COPPER MG/L	EXTRBLE ZINC MG/L	EXTRBLE CADMIUM MG/L	EXTRBLE MERCURY UG/L	EXTRBLE LEAD MG/L
1 00NF02ZM0015	0.0018	0.0197	L.0001	L.02	0.0010
2 00NF02ZM0015	0.0055	0.0377	L.0001	L.02	0.0032
3 00NF02ZM0015	0.0035	0.0385	L.0001	L.02	0.0033
4 00NF02ZM0015	0.0025	0.0388	L.0001	L.02	0.0032
5 00NF02ZM0015	0.0057	0.0407	0.0001	L.02	0.0042
6 00NF02ZM0015	0.0031	0.0484	0.0004	L.02	0.0061
7 00NF02ZM0015	0.0019	0.0421	0.0001	L.02	0.0007
8 00NF02ZM0015	0.0033	0.0570	0.0003	L.02	0.0036
9 00NF02ZM0015	0.0019	0.0257	0.0001	L.02	0.0013
10 00NF02ZM0015	0.0037	0.0202	0.0001	L.02	0.0015
11 00NF02ZM0015	0.0079	0.0137	L.0001	L.02	0.0011
12 00NF02ZM0015	0.0140	0.0100	0.0010	L.02	0.0020
13 00NF02ZM0015	0.0054	0.0181	L.0001	L.02	0.0034
14 00NF02ZM0015	0.0053	0.0069	0.0001	L.02	0.0006
15 00NF02ZM0015	0.0036	0.0086	L.0001	L.02	0.0013
16 00NF02ZM0015	0.0045	0.0093	0.0001	L.01	0.0016
17 00NF02ZM0015	0.0022	0.0271	L.0001	L.01	0.0013
18 00NF02ZM0015	0.0033	0.0324	0.0002	L.01	0.0024
19 00NF02ZM0015	0.0044	0.0426	0.0002	L.01	0.0025
20 00NF02ZM0015	0.0039	0.0473	0.0003	L.01	0.0035
21 00NF02ZM0015	0.0030	0.0415	0.0003	L.01	0.0010
22 00NF02ZM0015	0.0020	0.0292	L.0001	0.010	0.0010
23 00NF02ZM0015	0.0024	0.0301	0.0001	L.01	0.0019
24 00NF02ZM0015	0.0021	0.0297	L.0001		0.0009
25 00NF02ZM0015	0.0020	0.0195	L.0001	L.01	0.0006
26 00NF02ZM0015	0.0025	0.0140	L.0001	L.01	L.0002
27 00NF02ZM0015	0.0026	0.0119	L.0001	L.01	0.0007
28 00NF02ZM0015	0.0023	0.0086	L.0001	L.01	0.0010
29 00NF02ZM0015	0.0018	0.0080	0.0001	L.01	0.0012
30 00NF02ZM0015	0.0019	0.0073	L.0001	L.01	0.0003
31 00NF02ZM0015	0.0026	0.0231	0.0001	L.01	0.0004
32 00NF02ZM0015	0.0047	0.0294	0.0001	L.01	0.0013
33 00NF02ZM0015	0.0030	0.0384	0.0002	L.01	0.0010
34 00NF02ZM0015	0.0024	0.0434	0.0002	0.020	0.0007
35 00NF02ZM0015	0.0030	0.0508	0.0002	0.010	0.0009
36 00NF02ZM0015	0.0046	0.0458	0.0002	L.01	0.0013
37 00NF02ZM0015	0.0023	0.0343	0.0001	0.010	0.0033
38 00NF02ZM0015	0.0025	0.0218	0.0002	L.01	0.0004
39 00NF02ZM0015	0.0018	0.0153	L.0001	L.01	L.0002
40 00NF02ZM0015	0.0031	0.0121	L.0001	L.01	L.0002
41 00NF02ZM0015	0.0018	0.0069	L.0001	L.01	L.0002
42 00NF02ZM0015	0.0018	0.0076	0.0002	L.01	L.0002
43 00NF02ZM0015	0.0017	0.0079	0.0001	0.010	L.0002
44 00NF02ZM0015	0.0015	0.0077	0.0001	L.01	L.0002
45 00NF02ZM0015	0.0018	0.0153	0.0001	0.010	L.0002

TABLE 20

LONGTERM SURFACE WATER QUALITY DATA FOR THE OUTLET OF

QUDI VIDI LAKE NF02ZM0015 1986 - 1990

STATION	SAMPLE DATE	APPAR COLOUR REL UNIT	SP COND LAB USIE/CM	SP COND FIELD USIE/CM	TEMP FIELD DEG.C.	TURBID JTU	DISS OR CARBON MG/L	DISS NITRO NO3,NO2 MG/L	TOTAL NITRO MG/L
46 00NF02ZM0015	05-DEC-89	10.000	589.000	567.000	1.100	4.500	2.600	0.500	0.726
47 00NF02ZM0015	08-JAN-90	10.000	819.000	841.000	0.200	0.780	2.700	0.530	0.854
48 00NF02ZM0015	12-FEB-90	20.000	884.000	895.000	1.000	4.400	2.900	0.420	0.841
49 00NF02ZM0015	06-MAR-90	10.000	725.000	725.000	1.300	1.700	3.100	0.360	0.536
50 00NF02ZM0015	03-APR-90	5.000	1052.000	1042.000	3.000	0.600	2.300	0.520	0.728
51 00NF02ZM0015	11-MAY-90	20.000	775.000	753.000	6.800	0.520	2.500	0.420	0.607
52 00NF02ZM0015	11-MAY-90	20.000	750.000	753.000	6.800	0.550	2.300	0.400	0.610
53 00NF02ZM0015	11-MAY-90	10.000	764.000	753.000	6.800	0.580	2.300	0.420	0.610
54 00NF02ZM0015	06-JUN-90	20.000	461.000	473.000	12.400	0.840	3.600	0.530	0.838
55 00NF02ZM0015	04-JUL-90	30.000	450.000	446.000	16.600	0.650	3.400	0.380	0.624
56 00NF02ZM0015	14-AUG-90	10.000	533.000	522.000	22.400	0.810	2.900	0.390	0.580
57 MAXIMUM		40.000	1284.000	1078.000	22.400	5.000	4.300	0.700	0.925
58 MINIMUM		5.000	290.400	30.700	0.100	0.000	1.800	0.180	0.240
59 MEAN		10.446	559.854	558.763	8.386	0.901	2.824	0.372	0.571
60 MEDIAN		10.000	516.950	522.000	6.800	0.685	2.800	0.380	0.533
61 COUNT		56.000	56.000	56.000	56.000	56.000	55.000	56.000	55.000

STATION	DISS OXYGEN MG/L	TOTAL ALKALIN MG/L	PH LAB PH UNITS	PH FIELD PH UNITS	DISS SODIUM MG/L	DISS MAGNESIUM MG/L	EXTRBLE ALUMINUM MG/L	SILICA REACTIVE MG/L	TOTAL PHOSPH MG/L
46 00NF02ZM0015	13.700	8.200	7.200	6.590	95.900	2.220	0.222	2.560	0.024
47 00NF02ZM0015	13.300	7.300	6.800	6.370	138.000	2.600	0.111	4.260	0.021
48 00NF02ZM0015	13.000	6.200		6.400	153.000	2.230	0.317	3.440	0.022
49 00NF02ZM0015	13.200	6.000	6.800	6.480	124.000	1.780	0.251	2.910	0.029
50 00NF02ZM0015	11.400	7.900	6.700	6.440	178.000	2.600	0.084	3.440	0.020
51 00NF02ZM0015	12.500	6.000	7.300	6.400	122.000	2.700	0.080	1.820	0.015
52 00NF02ZM0015	12.500	6.000	7.300	6.480	122.000	2.700	0.082	1.800	0.015
53 00NF02ZM0015	12.500	6.000	7.300	6.650	122.000	2.700	0.081	1.800	0.015
54 00NF02ZM0015	11.100	3.100	7.300	6.510	74.000	1.980	0.109	1.570	0.015
55 00NF02ZM0015	9.900	8.100	7.300	6.690	69.500	1.980	0.043	1.370	0.012
56 00NF02ZM0015	8.600	10.400	7.500	6.810	80.500	2.520	0.041	0.250	0.007
57 MAXIMUM	15.200	13.100	7.700	7.320	178.000	2.700	0.317	4.510	0.029
58 MINIMUM	8.100	3.100	6.600	6.270	41.400	1.300	0.006	0.020	0.007
59 MEAN	11.524	8.659			89.951	2.091	0.093	1.869	0.016
60 MEDIAN	12.050	8.500			81.100	2.050	0.081	1.800	0.015
61 COUNT	56.000	56.000			56.000	56.000	56.000	44.000	55.000

TABLE 20
LONGTERM SURFACE WATER QUALITY DATA FOR THE OUTLET OF
QUDI VIDI LAKE NF02ZM0015 1986 - 1990

STATION	DISS SULPHATE MG/L	DISS SULPHATE IC-MG/L	DISS CHLORIDE MG/L	DISS POTASS MG/L	DISS CALCIUM MG/L	EXTRBLE MANGANE MG/L	EXTRBLE IRON MG/L	TOTAL COBALT MG/L	TOTAL NICKEL MG/L
46 00NF02ZM0015	12.300	12.900	159.000	1.980	10.600	0.234	0.487	0.0006	0.0008
47 00NF02ZM0015	15.600	15.100	227.000	2.030	14.100	0.368	0.408	0.0007	0.0004
48 00NF02ZM0015	17.400	17.900	246.000	2.230	13.400	0.428	0.613	0.0009	0.0009
49 00NF02ZM0015	11.500	13.900	202.000	1.730	10.600	0.314	0.492	0.0009	0.0008
50 00NF02ZM0015	16.800	16.800	291.000	2.150	15.900	0.531	0.372	0.0009	0.0004
51 00NF02ZM0015	13.500	11.400	222.000	1.830	14.400	0.355	0.302	0.0011	0.0010
52 00NF02ZM0015	13.800	11.300	222.000	1.850	14.400	0.355	0.298	0.0009	0.0010
53 00NF02ZM0015	14.100	11.400	222.000	1.860	14.400	0.359	0.315	0.0008	L.0002
54 00NF02ZM0015	11.000	9.940	128.000	1.400	10.100	0.216	0.325	0.0004	L.0002
55 00NF02ZM0015	9.500	10.500	120.000	1.260	9.930	0.213	0.201	0.0003	0.0003
56 00NF02ZM0015	9.500	11.200	146.000	1.430	12.500	0.094	0.170	0.0002	0.0004
57 MAXIMUM	17.800	21.700	291.000	2.780	15.900	0.541	0.861	0.0011	0.0017
58 MINIMUM	7.500	6.800	70.600	0.920	6.600	0.058	0.099	0.0001	L.0002
59 MEAN	11.812	11.663	148.375	1.470	10.999	0.236	0.336	0.0004	0.0005
60 MEDIAN	11.000	11.200	133.000	1.370	10.850	0.202	0.335	0.0004	0.0005
61 COUNT	55.000	56.000	56.000	56.000	56.000	56.000	56.000	55.0000	55.0000

STATION	EXTRBLE COPPER MG/L	EXTRBLE ZINC MG/L	EXTRBLE CADMIUM MG/L	EXTRBLE MERCURY UG/L	EXTRBLE LEAD MG/L
46 00NF02ZM0015	0.0035	0.0387	0.0003	L.01	0.0024
47 00NF02ZM0015	0.0025	0.0497	0.0003	L.01	0.0005
48 00NF02ZM0015	0.0039	0.0590	0.0003	L.01	0.0030
49 00NF02ZM0015	0.0036	0.0464	0.0003	0.010	0.0026
50 00NF02ZM0015	0.0029	0.0499	0.0003	0.010	0.0002
51 00NF02ZM0015	0.0023	0.0376	0.0002	0.030	L.0002
52 00NF02ZM0015	0.0025	0.0384	0.0003	0.010	0.0007
53 00NF02ZM0015	0.0020	0.0388	0.0001	0.010	L.0002
54 00NF02ZM0015	0.0021	0.0312	L.0001	0.020	0.0003
55 00NF02ZM0015	0.0026	0.0187	L.0001	0.010	0.0006
56 00NF02ZM0015	0.0019	0.0077	L.0001	0.020	L.0002
57 MAXIMUM	0.0140	0.0590	0.0010	0.030	0.0061
58 MINIMUM	0.0015	0.0069	0.0000	0.010	0.0002
59 MEAN	0.0032	0.0282	0.0000	0.014	0.0014
60 MEDIAN	0.0026	0.0294	0.0000	0.010	0.0010
61 COUNT	56.0000	55.0000	54.0000	54.000	55.0000

TABLE 21
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
QUALITY CONTROL TRIPLICATE SURFACE WATER SAMPLES OF
PHYSICAL VARIABLES, NUTRIENTS, MAJOR IONS, AND
EXTRACTABLE METALS

STATION	SAMPLE DATE	SAMPLE TIME	SP COND FIELD USIE/CM	PH FIELD PH UNITS	DIS O2 MG/L	TEMP FIELD DEG.C.	PH LAB PH UNITS	SP COND LAB USIE/CM	TURB JTU	TOTAL ALKALIN MG/L	APPARENT COLOUR REL UNITS
1 00NF02ZM0078	09-AUG-89	1000	920	6.3	6.7	19.6	6.3	907	0.7	5.1	10
2 00NF02ZM0078	09-AUG-89	1005	920	6.3	6.7	19.6	6.3	905	0.6	5.0	10
3 00NF02ZM0078	09-AUG-89	1010	920	6.3	6.7	19.6	6.4	907	0.6	5.2	10
4 00NF02ZM0083	09-AUG-89	1630	360	6.9	8.5	21.1	6.4	346	1.8	3.5	10
5 00NF02ZM0083	09-AUG-89	1635	360	6.9	8.5	21.1	6.4	345	1.8	3.3	10
6 00NF02ZM0083	09-AUG-89	1640	360	6.9	8.5	21.1	6.5	345	2.1	3.7	10
7 00NF02ZM0087	10-AUG-89	1700	440	7.3	8.9	19.3	7.1	439	0.4	9.5	5
8 00NF02ZM0087	10-AUG-89	1705	440	7.3	8.9	19.3	7.1	440	0.4	9.5	5
9 00NF02ZM0087	10-AUG-89	1710	440	7.3	8.9	19.3	7.1	440	0.4	9.8	5
10 00NF02ZM0006	15-AUG-89	1635	400	7.2	7.9	21.2	7.1	403	1.5	23.0	55
11 00NF02ZM0006	15-AUG-89	1640	400	7.2	7.9	21.2	7.0	404	1.5	22.5	55
12 00NF02ZM0006	15-AUG-89	1645	400	7.2	7.9	21.2	7.0	409	1.5	22.6	55
13 00NF02ZM0074	15-AUG-89	1835	260	5.1	7.2	25.2	5.2	256	1.7	0.1	110
14 00NF02ZM0074	15-AUG-89	1840	260	5.1	7.2	25.2	5.1	257	1.6	0.3	110
15 00NF02ZM0074	15-AUG-89	1845	260	5.1	7.2	25.2	5.1	259	1.8	0.1	110

STATION	DISS CALCIUM MG/L	DISS MAGNES MG/L	DISS POTASS MG/L	DISS SODIUM MG/L	DISS CHLORIDE MG/L	DISS SULPHATE MTB MG/L	DISS SULPHATE MG/L	TOTAL PHOSPH. MG/L	EXTRBLE COPPER MG/L	EXTRBLE ZINC MG/L	EXTRBLE CADMIUM MG/L
1 00NF02ZM0078	11.0	2.3	2.80	160.0	270.0	10.6	9.7	0.032	0.004	0.01	L.001
2 00NF02ZM0078	13.0	2.3	2.90	163.0	263.9	10.9	9.6	0.032	0.004	0.01	L.001
3 00NF02ZM0078	11.0	2.2	2.80	161.0	264.0	10.7	9.6	0.033	0.004	0.01	L.001
4 00NF02ZM0083	9.7	2.0	1.00	51.0	98.0	8.1	7.8	0.024	0.003	0.03	L.001
5 00NF02ZM0083	10.0	2.0	1.00	52.0	99.0	8.4	7.7	0.024	0.003	0.03	L.001
6 00NF02ZM0083	10.0	2.1	1.00	51.0	100.0	8.4	7.8	0.024	0.003	0.03	L.001
7 00NF02ZM0087	14.0	3.2	1.20	64.0	120.0	9.6	8.9	0.009	L.002	0.03	L.001
8 00NF02ZM0087	13.4	2.8	1.40	64.0	127.0	9.6	8.9	0.008	L.002	0.04	L.001
9 00NF02ZM0087	13.4	2.8	1.40	64.0	129.0	9.6	9.1	0.009	L.002	0.03	L.001
10 00NF02ZM0006	13.7	3.3	3.40	57.0	103.0	6.6	6.2	0.012	L.002	0.01	L.001
11 00NF02ZM0006	13.7	3.3	3.40	57.0	105.0	6.6	6.4	0.012	L.002	0.01	L.001
12 00NF02ZM0006	13.7	3.3	4.00	60.0	104.0	6.5	6.2	0.012	L.002	0.01	L.001
13 00NF02ZM0074	11.5	1.5	0.72	38.0	82.0	3.1	2.3	0.011	L.002	L.01	L.001
14 00NF02ZM0074	11.5	1.5	0.73	38.0	82.0	3.1	2.3	0.011	L.002	0.01	L.001
15 00NF02ZM0074	11.5	1.5	0.75	37.6	80.0	3.1	2.3	0.011	L.002	0.01	L.001

TABLE 21
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
QUALITY CONTROL TRIPLICATE SURFACE WATER SAMPLES OF
PHYSICAL VARIABLES, NUTRIENTS, MAJOR IONS, AND
EXTRACTABLE METALS

STATION	EXTRBLE LEAD MG/L	EXTRBLE ALUMINUM MG/L	EXTRBLE IRON MG/L	EXTRBLE MANGAN MG/L	DIS OR CARBON MG/L	DISS NITRO NO3,NO2 MG/L	TOTAL NITRO MG/L	SILICA (MB) MG/L	EXTRBLE MERCURY MG/L
1 00NF02ZM0078	L.002	0.030	0.32	0.88	1.9	0.14	0.35	3.7	L.02
2 00NF02ZM0078	L.002	0.027	0.34	0.87	2.1	0.11	0.28	3.7	L.02
3 00NF02ZM0078	L.002	0.026	0.32	0.86	2.1	0.13	0.37	3.7	L.02
4 00NF02ZM0083	L.002	0.120	0.35	0.22	2.3	0.12	0.24	2.7	L.02
5 00NF02ZM0083	L.002	0.120	0.36	0.22	2.4	0.11	0.22	2.7	L.02
6 00NF02ZM0083	0.002	0.120	0.36	0.22	2.3	0.12	0.26	2.7	L.02
7 00NF02ZM0087	L.002	0.027	0.13	0.17	2.0	0.42	0.57	6.3	L.02
8 00NF02ZM0087	L.002	0.024	0.13	0.17	2.0	0.41	0.49	6.0	L.02
9 00NF02ZM0087	L.002	0.020	0.11	0.15	1.9	0.41	0.49	6.1	L.02
10 00NF02ZM0006	L.002	0.034	0.93	1.10	5.0	0.13	0.31	5.8	L.02
11 00NF02ZM0006	L.002	0.028	0.92	1.10	5.0	0.13	0.30	5.8	0.04
12 00NF02ZM0006	L.002	0.027	0.94	1.10	5.2	0.13	0.32	5.7	L.02
13 00NF02ZM0074	L.002	0.180	2.80	0.78	6.5	L.01	0.28	2.6	L.02
14 00NF02ZM0074	L.002	0.190	3.10	0.76	6.3	L.01	0.28	2.6	L.02
15 00NF02ZM0074	L.002	0.170	2.90	0.78	6.2	L.01	0.26	2.6	L.02

TABLE 22
QUIDI VIDI BASIN RECURRENT SURVEY 1990
QUALITY CONTROL TRIPLICATE SURFACE WATER SAMPLES OF
PHYSICAL VARIABLES, NUTRIENTS, MAJOR IONS, AND
EXTRACTABLE METALS

STATION	SAMPLE DATE	SAMPLE TIME	PH FIELD PH UNITS	DIS O2 MG/L	SP COND FIELD USIE/CM	TEMP FIELD DEG.C.	PH LAB PH UNITS	SP COND LAB USIE/CM	TURB JTU	TOTAL ALKALIN MG/L	APPARENT COLOUR REL UNITS
1 00NF02ZM0124	07-AUG-90	1530	6.8	9.10	197.7	18.30	6.6	290	0.8	4.2	L5.
2 00NF02ZM0124	07-AUG-90	1535	6.8	9.10	197.7	18.30	6.5	290	0.7	4.1	5
3 00NF02ZM0124	07-AUG-90	1540	6.8	9.10	197.7	18.30	6.6	290	0.8	4.0	5
4 00NF02ZM0131	08-AUG-90	1515	6.9	9.46	105.2	17.12	6.7	99	0.3	4.5	L5.
5 00NF02ZM0131	08-AUG-90	1520	6.9	9.46	105.2	17.10	6.7	100	0.3	4.6	L5.
6 00NF02ZM0131	08-AUG-90	1525	6.9	9.46	105.2	17.10	6.6	99	0.3	4.7	L5.
7 00NF02ZM0147	14-AUG-90	1500	6.7	10.50	1066.0	13.70	6.8	1020	0.6	16.8	L5.
8 00NF02ZM0147	14-AUG-90	1505	6.7	10.50	1066.0	13.70	6.8	1040	0.5	16.9	L5.
9 00NF02ZM0147	14-AUG-90	1510	6.7	10.50	1066.0	13.70	6.7	970	0.7	17.0	5

STATION	DISS CALCIUM MG/L	DISS MAGNES MG/L	DISS POTASS MG/L	DISS SODIUM MG/L	DISS CHLORIDE MG/L	DISS SULPHATE MTB MG/L	DISS SULPHATE MG/L	TOTAL PHOSPH. MG/L	EXTRBLE COPPER MG/L	EXTRBLE ZINC MG/L	EXTRBLE CADMIUM MG/L
1 00NF02ZM0124	5.3	1.4	0.93	49.0	80.0	5.64	5.9	0.020	0.002	0.03	L.001
2 00NF02ZM0124	5.0	1.4	0.93	49.0	80.0	5.75	5.9	0.022	0.002	0.03	L.001
3 00NF02ZM0124	5.0	1.4	0.93	48.0	80.0	5.75	5.8	0.020	0.002	0.03	L.001
4 00NF02ZM0131	4.1	1.1	0.67	12.4	19.8	3.82	3.8	0.008	0.002	L.01	L.001
5 00NF02ZM0131	4.1	1.3	0.64	12.5	19.0	3.97	3.8	0.007	0.002	L.01	L.001
6 00NF02ZM0131	4.1	1.3	0.64	12.3	19.6	3.88	3.9	0.007	0.002	L.01	L.001
7 00NF02ZM0147	30.0	6.3	2.70	146.0	250.0	21.95	22.0	0.050	0.005	0.11	L.001
8 00NF02ZM0147	29.0	6.3	2.70	155.0	250.0	22.13	22.0	0.055	0.006	0.11	L.001
9 00NF02ZM0147	30.0	6.3	2.70	146.0	250.0	21.83	22.0	0.050	0.006	0.12	L.001

STATION	EXTRBLE LEAD MG/L	EXTRBLE ALUMINUM MG/L	TOTAL ARSENIC MG/L	EXTRBLE MANGAN MG/L	EXTRBLE MERCURY MG/L	DISS ORG CARBON MG/L	DISS NITRO(NO3,NO2) MG/L	TOTAL NITRO MG/L	SILICA (MB) MG/L	EXTRBLE IRON MG/L
1 00NF02ZM0124	L.002	0.052	L.0005	0.23	L.02	2.2	0.32	0.39	4.5	0.390
2 00NF02ZM0124	L.002	0.045	L.0005	0.18	L.02	2.2	0.3	0.38	4.4	0.370
3 00NF02ZM0124	L.002	0.046	L.0005	0.20	L.02	2.1	0.31	0.40	4.5	0.380
4 00NF02ZM0131	L.002	0.030	L.0005	0.01	L.02	2.5	2	2.10	4.2	0.028
5 00NF02ZM0131	L.002	0.027	L.0005	0.01	L.02	L.5	2	1.60	4.2	0.026
6 00NF02ZM0131	L.002	0.026	L.0005	0.01	L.02	L.5	2	1.40	4.1	0.050
7 00NF02ZM0147	L.002	0.046	L.0005	0.23	L.02	1.3	2.6	3.40	7.4	0.100
8 00NF02ZM0147	L.002	0.050	L.0005	0.22	L.02	1.1	2.6	2.20	7.4	0.100
9 00NF02ZM0147	L.002	0.046	L.0005	0.23	L.02	1.2	2.4	2.00	6.4	0.090

TABLE 23
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
QUALITY CONTROL DISTILLED WATER SAMPLES OF
EXTRACTABLE METALS AND TOTAL PHOSPHORUS

	STATION	SAMPLE DATE	TOTAL PHOSPHORUS MG/L	EXTRACT COPPER MG/L	EXTRACT ZINC MG/L	EXTRACT CADMIUM MG/L	EXTRACT LEAD MG/L	EXTRACT ALUMINUM MG/L	EXTRACT MANGANESE MG/L	EXTRACT MERCURY UG/L	EXTRACT IRON MG/L
1	00NF02ZM9900	02-MAY-89	L.001	L.002	L.01	L.001	L.002	L.010	L.01	L.02	L.002
2	00NF02ZM9900	25-MAY-89	0.001	L.002	L.01	L.001	L.002	L.010	L.01	L.02	0.002
3	00NF02ZM9900	04-JUL-89	L.001	L.002	L.01	L.001	L.002	L.010	L.01	L.02	0.006
4	00NF02ZM9900	31-JUL-89	L.001	L.002	L.01	L.001	L.002	L.010	L.010	L.02	0.003
5	00NF02ZM9900	14-AUG-89	0.001	L.002	L.01	L.001	L.002	L.010	L.010	L.02	L.002
6	00NF02ZM9900	18-AUG-89	L.001	L.002	L.01	L.001	L.002	L.010	L.010	L.02	L.002

TABLE 24

QUIDI VIDI BASIN RECURRENT SURVEY 1990

QUALITY CONTROL DISTILLED WATER SAMPLES OF

EXTRACTABLE METALS AND TOTAL PHOSPHORUS

	STATION	SAMPLE DATE	TOTAL PHOSPHORUS MG/L	EXTRACT COPPER MG/L	EXTRACT ZINC MG/L	EXTRACT CADMIUM MG/L	EXTRACT LEAD MG/L	EXTRACT ALUMINUM MG/L	EXTRACT MANGANESE MG/L	EXTRACT MERCURY UG/L	EXTRACT IRON MG/L
1	00NF02ZM9951	10-MAY-90	0.002	L.002	L.01	L.001	L.002	L.010	L.010	L.02	L.002
2	00NF02ZM9951	28-MAY-90	L.001	L.002	L.01	L.001	L.002	L.01	L.010	L.02	L.002
3	00NF02ZM9900	26-JUN-90	L.001	L.002	L.01	L.001	L.002	L.010	L.01	L.02	L.002
4	00NF02ZM9900	31-JUL-90	L.001	L.002	L.01	L.001	L.002	L.010	L.01	L.02	0.002
5	00NF02ZM9900	15-AUG-90	L.001	L.002	L.01	L.001	L.002	L.010	L.01	L.02	0.003

TABLE 25
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
QUALITY CONTROL SURFACE WATER AND DISTILLED WATER ANALYSIS
FOR ORGANOCHLORINES, CHLORINATED BENZENES, POLYNUCLEAR AROMATIC
HYDROCARBONS, AND CHLORINATAED PHENOLS IN NG/L

	TYPE	STATION		SAMPLE DATE		ALPHA BHC	GAMMA BHC	HEPTA-CHLOR	ALDRIN	HEPTA-CHLOR-EPOXIDE	GAMMA CHLORDANE
1	SPK SAMPLE	00NF02ZMFS89	905595	14-AUG-89	1120	4.49	4.57	3.50	L.4	L.4	2.75
2	SPK SAMPLE	00NF02ZMFS89	905596	14-AUG-89	1125	9.95	9.37	5.95	L.4	L.4	6.47
3	SPK BLANK	00NF02ZMFD89	905597	14-AUG-89	1130	9.35	9.25	2.78	L.4	L.4	5.25
4	BLANK	00NF02ZM9989	905598	14-AUG-89	1135	L.4	L.4	L.4	L.4	L.4	L.4
5											
6	SPK SAMPLE	00NF02ZMFS92	905601	14-AUG-89	1635	5.06	5.03	5.47	L.4	L.4	3.71
7	SPK SAMPLE	00NF02ZMFS92	905602	14-AUG-89	1640	3.15	4.19	4.46	L.4	L.4	0.94
8	SPK BLANK	00NF02ZMFD92	905603	14-AUG-89	1645	5.22	6.75	5.37	L.4	L.4	0.86
9	BLANK	00NF02ZM9992	905604	14-AUG-89	1650	L.4	L.4	L.4	L.4	L.4	L.4

	ALPHA CHLORDANE	ALPHA ENDOSULFAN	PP-DDE	HEOD\ DIELDRIN	ENDRIN	OP-DDT	PP-TDE	PP-DDT	BETA-ENDO-SULFAN	MIREX	METHOXY CHLOR
1	2.61	3.04	4.21	L.4	L.4	L.4	L.4	9.91	7.38	4.55	17.2
2	6.68	5.89	4.23	L.4	L.4	L.4	L.4	22.80	13.80	5.68	30.6
3	4.45	6.50	10.40	L.4	L.4	L.4	L.4	31.30	16.00	11.80	40.5
4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4
5											
6	3.44	3.83	8.23	L.4	L.4	L.4	L.4	26.10	3.56	8.74	11.1
7	0.66	3.16	5.40	L.4	L.4	L.4	L.4	15.60	3.28	6.53	10.2
8	0.40	1.36	10.60	L.4	L.4	L.4	L.4	L.4	0.61	13.40	18.6
9	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4

	TOTAL PCB'S	1,3 DI-CHLORO-BENZENE	1,4 DI-CHLORO-BENZENE	1,2 DI-CHLORO-BENZENE	1,3,5 TRI-CHLORO-BENZENE	1,2,4 TRI-CHLORO-BENZENE	1,2,3 TRI-CHLORO-BENZENE	1,2,3,4 TETRA-CHLORO-BENZENE	HEXA-CHLORO-BENZENE	PENTA-CHLORO-BENZENE
1	L9	24.3	L5	6.40	3.33	L1	L1	2.04	1.10	L1
2	L9	28.3	14.50	L5	10.10	L1	L1	3.92	2.32	L1
3	L9	12.7	L5	L5	3.96	L1	L1	1.70	1.39	L1
4	L9	L5	8.05	L5	L1	L1	L1	L1	L.4	L1
5										
6	L9	29.4	L5	L5	8.28	L1	L1	2.98	1.82	L1
7	L9	L5	8.00	6.94	6.65	L1	L1	2.48	1.39	L1
8	L9	36.6	13.30	7.19	12.00	L1	L1	4.46	2.51	L1
9	L9	L5	7.16	L5	L1	L1	L1	L1	L.4	L1

TABLE 25
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
QUALITY CONTROL SURFACE WATER AND DISTILLED WATER ANALYSIS
FOR ORGANOCHLORINES, CHLORINATED BENZENES, POLYNUCLEAR AROMATIC
HYDROCARBONS, AND CHLORINATAED PHENOLS IN NG/L

	INDENE	1,2,3,4-TETRAHYDRO-NAPHTALENE	2-METHYL-NAPHTA-LENE	1-METHYL-NAPHTA-LENE	B-CHLORO-NAPHTA-LENE	ACENAPH-THYLENE	ACENAPH-THENE	FLUORENE	PHENAN-THRENE	PYRENE	FLUOR-ANTHENE
1	L10	L10	L10	L10	L10	L10	14.7	L15	L15	L15	L15
2	L10	L10	L10	L10	L10	L10	26.2	L15	23.4	21.9	L15
3	L10	L10	L10	L10	L10	L10	16.6	L15	20.8	L15	L15
4	L10	L10	L10	L10	L10	L10	L10	L15	L15	L15	L15
5											
6	L10	L10	L10	L10	L10	L10	19.7	L15	L15	L15	L15
7	L10	L10	L10	L10	L10	L10	15.8	L15	L15	L15	L15
8	L10	L10	L10	L10	L10	L10	29.9	L15	23.0	18.8	L15
9	L10	L10	L10	L10	L10	L10	L10	L15	L15	L15	L15

	BENZO(b)-FLUOR-ANTHENE	BENZO(k)-FLUOR-ANTHENE	BENZO(a)-PYRENE	INDENO-(1,2,3-cd) PYRENE	BENZO(g,h,i) PERYLENE	O-CHLORO-PHENOL	M-CHLORO-PHENOL	P-CHLORO-PHENOL	2 CL-5-METHYL-PHENOL	2,6 DI-CHLORO-PHENOL
1	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
2	L30	L30	L30	L30	32.9	L65	L50	L40	L105	L55
3	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
4	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
5										
6	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
7	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55
8	L30	L30	L30	L30	82.3	L65	L50	L40	L105	L55
9	L30	L30	L30	L30	L30	L65	L50	L40	L105	L55

	3 MET-4 CHLORO-PHENOL	2,4 DI-CHLORO-PHENOL	3,5 DI-CHLORO-PHENOL	2,3 DI-CHLORO-PHENOL	3,4 DI-CHLORO-PHENOL	2,4,6 TRI-CHLORO-PHENOL	2,3,6 TRI-CHLORO-PHENOL	2,3,5 TRI-CHLORO-PHENOL	2,4,5 TRI-CHLORO-PHENOL	2,3,4 TRI-CHLORO-PHENOL
1	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
2	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
3	L65	L50	L35	L65	L40.0	L50	L65	56.9	L45	L60
4	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
5										
6	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
7	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60
8	L65	59	L35	L65	L40.0	L50	L65	72.8	L45	L60
9	L65	L50	L35	L65	L40.0	L50	L65	L55	L45	L60

TABLE 25
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
QUALITY CONTROL SURFACE WATER AND DISTILLED WATER ANALYSIS
FOR ORGANOCHLORINES, CHLORINATED BENZENES, POLYNUCLEAR AROMATIC
HYDROCARBONS, AND CHLORINATAED PHENOLS IN NG/L

	3,4,5 TRI-CHLORO-PHENOL	2,3,5,6 TET-RACHLORO-PHENOL	2,3,4,6 TET-RACHLORO-PHENOL	2,3,4,5 TET-RACHLORO-PHENOL	PENTA-CHLORO-PHENOL	VOLUME (Lt)
1	L70	L80	L60	L90	L85	3.6
2	L70	L80	L60	L90	L85	3.7
3	L70	L80	L60	L90	L85	4.0
4	L70	L80	L60	L90	L85	4.0
5						
6	L70	L80	L60	L90	L85	3.5
7	L70	L80	L60	L90	L85	3.5
8	L70	L80	L60	L90	L85	3.7
9	L70	L80	L60	L90	L85	3.9

TABLE 26

QUIDI VIDI BASIN RECURRENT SURVEY 1990

QUALITY CONTROL SURFACE WATER AND DISTILLED WATER ANALYSIS

FOR ORGANOCHLORINES, CHLORINATED BENZENES, POLYNUCLEAR AROMATIC

HYDROCARBONS, AND CHLORINATAED PHENOLS IN NG/L

	TYPE	STATION	SAMPLE DATE	STIME	ALPHA BHC	GAMMA BHC	HEPTA-CHLOR	ALDRIN	HEPTA-CHLOR-EPOXIDE	GAMMA CHLORDANE	ALPHA CHLORDANE
1	SPK SAMPLE	00NF02ZM0127	08-AUG-90	1050	14.3	13.9	9.5	13.3	14.3	14.9	14.3
2	SPK SAMPLE	00NF02ZM0127	08-AUG-90	1055	14.2	14.0	10.0	14.4	14.4	15.1	14.6
3	SPK BLANK	00NF02ZM0127	08-AUG-90	1100	11.8	12.2	5.4	9.6	12.4	12.3	11.9
4	BLANK	00NF02ZM0127	08-AUG-90	1105	L.4	L.4		L.4	L.4	L.4	L.4
5											
6	SPK SAMPLE	00NF02ZM0144	14-AUG-90	950	13.9	13.6	L.4	8.6	14.0	14.9	11.9
7	SPK BLANK	00NF02ZM0144	14-AUG-90	1000	9.4	9.1	7.5	7.0	9.5	10.1	8.3
8	BLANK	00NF02ZM0144	14-AUG-90	1005	L.4	L.4	L.4	L.4	L.4	L.4	L.4

	ALPHA ENDOSULFAN	PP-DDE	HEOD\DIELDRIN	ENDRIN	OP-DDT	PP-TDE	PP-DDT	BETA-ENDO-SULFAN	MIREX	METHOXY CHLOR	TOTAL PCB'S
1	12.7	22.2	14.6	30.1	40.5	31.9	50.0	31.6	45.9	66.2	897
2	12.6	25.2	14.8	30.7	47.5	33.4	51.7	33.4	68.4	71.2	827
3	10.1	16.6	12.7	27.5	30.8	29.8	46.9	28.6	33.9	60.6	702
4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0
5											
6	14.4	15.9	15.5	33.7	20.3	39.3	62.8	33.3	8.2	105.6	611
7	9.7	18.8	10.5	22.3	19.7	25.6	35.6	22.3	10.8	57.7	673
8	L.4	L.4	0.4	L.4	L.4	L.4	L.4	L.4	L.4	L.4	L9.0

	1,3 DI-CHLORO-BENZENE	1,4 DI-CHLORO-BENZENE	1,2 DI-CHLORO-BENZENE	1,3,5 TRI-CHLORO-BENZENE	1,2,4 TRI-CHLORO-BENZENE	1,2,3 TRI-CHLORO-BENZENE	1,2,3,4 TETRA-CHLORO-BENZENE	HEXA-CHLORO-BENZENE	PENTA-CHLORO-BENZENE	INDENE
1	123.9	271.5	201.3	44.9	42.1	23.3	15.9	7.8	7.9	L10.0
2	93.4	226.3	154.2	36.2	34.1	18.7	13.3	7.2	6.8	L10.0
3	85.8	286.1	142.4	34.5	32.0	17.4	12.6	6.6	6.5	L10.0
4	L5.0	73.8	L5.0	L1.0	L1.0	L1.0	L1.0	L.4	L1.0	L10.0
5										
6	80.3	129.0	118.5	23.1	27.5	11.8	8.5	4.5	4.2	L10.0
7	104.5	216.5	151.3	27.3	30.0	15.4	11.2	5.8	5.5	L10.0
8	L5.0	9.8	L5.0	L1.0	4.7	L1.0	L1.0	L.4	L1.0	L10.0

TABLE 26
QUIDI VIDI BASIN RECURRENT SURVEY 1990
QUALITY CONTROL SURFACE WATER AND DISTILLED WATER ANALYSIS
FOR ORGANOCHLORINES, CHLORINATED BENZENES, POLYNUCLEAR AROMATIC
HYDROCARBONS, AND CHLORINATAED PHENOLS IN NG/L

	1,2,3,4-TETRAHYDRO-NAPHTALENE	2-METHYL-NAPHTA-LENE	1-METHYL-NAPHTA-LENE	B-CHLORO-NAPHTA-LENE	ACENAPH-THYLENE	ACENAPH-THENE	FLUORENE	PHENAN-THRENE	PYRENE	FLUOR-ANTHENE
1	L10.0	L10.0	L10.0	L10.0	L10.0	31.9	20.3	26.5	L15.0	L15.0
2	L10.0	L10.0	L10.0	L10.0	L10.0	27.2	20.1	27.4	L15.0	L15.0
3	L10.0	L10.0	L10.0	L10.0	L10.0	28.2	21.3	27.3	L15.0	L15.0
4	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0	L15.0	L15.0
5										
6	L10.0	L10.0	L10.0	L10.0	L10.0	38.1	34.3	46.5	16.7	33.1
7	L10.0	L10.0	L10.0	L10.0	L10.0	26.7	19.5	25.3	L15.0	L15.0
8	L10.0	L10.0	L10.0	L10.0	L10.0	L10.0	L15.0	L15.0	L15.0	L15.0

	BENZO(b)-FLUOR-ANTHENE	BENZO(k)-FLUOR-ANTHENE	BENZO(a)-PYRENE	INDENO-(1,2,3-cd) PYRENE	BENZO(g,h,i) PERYLENE	O-CHLORO-PHENOL	M-CHLORO-PHENOL	P-CHLORO-PHENOL	2 CL-5-METHYL-PHENOL	2,6 DI-CHLORO-PHENOL
1	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50	L40	L105	L55
2	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50	L40	L105	L55
3	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50	L40	L105	L55
4	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50	L40	L105	L55
5										
6	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50	L40	L105	L55
7	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50	L40	L105	153
8	L30.0	L30.0	L30.0	L30.0	L30.0	L65	L50	L40	L105	L55

	3 MET-4 CHLORO-PHENOL	2,4 DI-CHLORO-PHENOL	3,5 DI-CHLORO-PHENOL	2,3 DI-CHLORO-PHENOL	3,4 DI-CHLORO-PHENOL	2,4,6 TRI-CHLORO-PHENOL	2,3,6 TRI-CHLORO-PHENOL	2,3,5 TRI-CHLORO-PHENOL	2,4,5 TRI-CHLORO-PHENOL	2,3,4 TRI-CHLORO-PHENOL
1	L65	L50	L35	L65	L40	L50	L65	L55	L45	L60
2	L65	L50	L35	L65	L40	L50	L65	L55	L45	L60
3	L65	L50	L35	L65	L40	L50	L65	L55	L45	L60
4	L65	L50	L35	L65	L40	L50	L65	L55	L45	L60
5										
6	L65	L50	L35	L65	L40	371	L65	L55	L45	L60
7	L65	54	70	L65	64	L50	L65	L55	L45	L60
8	L65	L50	L35	L65	L40	L50	L65	L65	L45	L60

TABLE 26
QUIDI VIDI BASIN RECURRENT SURVEY 1990
QUALITY CONTROL SURFACE WATER AND DISTILLED WATER ANALYSIS
FOR ORGANOCHLORINES, CHLORINATED BENZENES, POLYNUCLEAR AROMATIC
HYDROCARBONS, AND CHLORINATAED PHENOLS IN NG/L

	3,4,5 TRI-CHLORO-PHENOL	2,3,5,6 TET-RACHLORO-PHENOL	2,3,4,6 TET-RACHLORO-PHENOL	2,3,4,5 TET-RACHLORO-PHENOL	PENTA-CHLORO-PHENOL	VOLUME (Lt)
1	L70	L80	L60	L90	L85	3.60
2	L70	L80	L60	L90	L85	3.62
3	L70	L80	L60	L90	L85	4.08
4	L70	L80	L60	L90	L85	3.80
5						
6	L70	L80	L60	L90	L85	3.88
7	L70	L80	L60	L90	L85	3.94
8	L70	L80	L60	L90	L85	3.97

TABLE 27
WATERFORD RIVER BASIN RECURRENT SURVEY 1989
QUALITY CONTROL SURFACE WATER AND DISTILLED WATER PERCENT
RECOVERIES FROM 100 ul OF A ORGANIC SPIKING SOLUTION

	00NF02ZM0089			00NF02ZM0092		
1	SPIKE 1	SPIKE2	SPIKE BLANK	SPIKE 1	SPIKE 2	SPIKE BLANK
2	14 AUG 89	14 AUG 89	14 AUG 89	14 AUG 89	14 AUG 89	14 AUG 89
3	11:20:00	11:25:00	11:30:00	16:35:00	11:40:00	16:45:00
4	ZMFS89	ZMFS89	ZMFS89	ZMFS92	ZMFS92	ZMFD92
5	#905595	#905596	#905597	#905601	#905602	#905603
6						
7 ALPHA BHC	35.5	86.9	93.6	40.5	23.8	48.3
8 GAMMA BHC	36.7	82.1	92.5	44.1	36.8	62.5
9 HEPTACHLOR	31.5	55	27.8	48	39.1	49.7
10 GAMMA CHLORDANE	24.8	59.8	53.8	33.3	8.4	8.16
11 ALPHA CHLORDANE	22.7	59.6	42.9	29.1	5.6	3.6
12 ALPHA ENDOSULFAN	28	55.7	66.7	33.6	27.7	12.8
13 PP' DDE	37.9	39.1	104	72.2	47.4	98.1
14 PP' DDT	29.8	70.4	104	76.1	45.5	0
15 BETA ENDOSULFAN	33.2	63.9	80	15.5	14.3	2.8
16 MIREX	13.7	17.5	39.3	25.5	19	41.4
17 METHOXY-CHLOR	38.7	70.8	101.1	24.3	22.3	43
18 1,3 DICHLOROBENZENE	29.2	34.9	16.9	34.3	0	45
19 1,3,5 TRICHLOROBENZENE	17.2	53.4	22.6	41.4	33.2	63.5
20 1,2,3,4 TETRECHLOROBENZE	36.4	72.6	34	52.2	43.4	82.6
21 HEXACHLOROBEZENE	39.6	85.9	55.6	63.6	48.6	93
22 ACENAPHTHENE	26.4	48.5	33.2	34.5	27.7	55.4
23 PHENANTHRENE	NA	57.8	55.5	NA	NA	56.8
24 PYRENE	NA	81.1	NA	NA	NA	69.6
25 FLUORANTHENE	NA	NA	NA	NA	NA	NA
26 BENZO(b)FLUORANTHENE	NA	NA	NA	NA	NA	NA
27 BENZO(k)FLUORANTHENE	NA	NA	NA	NA	NA	NA
28 BENZO(a)PYRENE	NA	NA	NA	NA	NA	NA
29 INDENO(1,2,3-cd)PYRENE	NA	NA	NA	NA	NA	NA
30 BENZO(g,h,i)PERYLENE	NA	81	NA	NA	NA	202.7
31 2,4 DICHLPHENOL	NA	NA	NA	NA	NA	72.7
32 2,6 DICHLPHENOL	NA	NA	NA	NA	NA	NA
33 2,3,5 TRICHLPHENOL	NA	NA	75	NA	NA	89
34 2,4,6 TRICHLPHENOL	NA	NA	NA	NA	NA	NA
35 2,3,4,5 TETCHLPHENOL	NA	NA	NA	NA	NA	NA
36 2,3,5,6 TETCHLPHENOL	NA	NA	NA	NA	NA	NA
37 PENTACHLPHENOL	NA	NA	NA	NA	NA	NA

NA = NOT APPLICABLE

TABLE 28
QUIDI VIDI BASIN RECURRENT SURVEY 1990
QUALITY CONTROL SURFACE WATER AND DISTILLED WATER PERCENT
RECOVERIES FROM 100 ul OF A ORGANIC SPIKING SOLUTION

	NF02ZM0127			NF02ZM0144	
1	SPIKE 1	SPIKE2	SPIKE BLANK	SPIKE1	SPIKE BLAN
2	08 AUG 90	08 AUG 90	08 AUG 90	14 AUG 90	14 AUG 90
3	10:50:00	10:55:00	11:00:00	09:50:00	10:00:00
4	ZM0127	ZM0127	ZM0127	ZM0144	ZM0144
5	#105114	#105155	#105116	#105144	#105145
6					
7 ALPHA BHC	102.9	103.1	96.3	102.5	74.1
8 GAMMA BHC	100.1	101.7	99.6	105.5	71.7
9 HEPTACHLOR	68.4	72.6	44.1	0	59.1
10 ALDRIN	95.8	104.6	78.4	66.7	55.2
11 HEPTACHL EPOX	102.9	104.6	101.2	108.6	74.9
12 GAMMA CHLORDANE	107.3	109.7	100.4	115.6	79.6
13 ALPHA CHLORDANE	102.9	106	97.1	92.3	65.4
14 ALPHA ENDOSULFAN	91.4	91.5	82.4	111.7	76.4
15 PP' DDE	159.8	183	135.5	123.3	148.1
16 HEOD/DIELDRIN	105.1	107.5	103.7	117.1	82.7
17 ENDRIN	108.4	111.2	112.2	130.8	87.9
18 OP'DDT	145.8	172	125.7	78.8	77.6
19 OP'TDE(PP'DDD)	115	120.9	121.6	152.5	100.9
20 PP' DDT	119.9	124.8	127.6	162.4	93.5
21 BETA ENDOSULFAN	113.8	120.9	116.7	129.2	87.9
22 MIREX	110.1	165	92.2	21.2	28.4
23 METHOXY-CHLOR	119.1	128.9	123.6	204.8	113.7
24 P.C.B.	107.6	99.8	95.5	79	88.4
25 1,3 DICHLOROBENZENE	59.5	45.1	46.7	41.5	54.9
26 1,4 DICHLOROBENZENE	73.6	60.9	69.3	32.1	68.2
27 1,2 DICHLOROBEZENE	62	47.2	51.6	40.9	52.9
28 1,3,5 TRICHLOROBENZENE	92.4	74.9	80.4	51.2	61.5
29 1,2,4 TRICHLOROBENZENE	101	82.3	87	65.4	78.8
30 1,2,3 TRICHLOROBENZENE	111.9	90.3	94.7	61	80.9
31 1,2,3,4 TETRECHLOROBENZE	114.5	96.3	102.9	65.9	88.2
32 HEXACHLOROBEZENE	112.4	104.2	107.6	69.9	91.3
33 PENTACHLOROBENZENE	113.8	98.4	106	65.2	86.6
34 ACENAPHTHYLENE	NA	NA	NA	NA	NA
35 PHENANTHRENE	63.6	66.1	74.3	120.3	66.5
36 PYRENE	NA	NA	NA	64.8	NA
37 FLUORANTHENE	NA	NA	NA	256.8	NA
38 BENZO(b)FLUORANTHENE	NA	NA	NA	NA	NA
39 BENZO(k)FLUORANTHENE	NA	NA	NA	NA	NA
40 BENZO(a)PYRENE	NA	NA	NA	NA	NA
41 INDENO(1,2,3-cd)PYRENE	NA	NA	NA	NA	NA
42 BENZO(g,h,i)PERYLENE	NA	NA	NA	NA	NA

NA = NOT APPLICABLE

TABLE 29

Spiking Solutions: Waterford River Survey 1989

Solution A June 1/89

	Concentration µg/L
P,P DDT	1.2
P,P DDE	0.4
p,p Methoxychlor	1.6
Heptachlor	0.4
Alpha Endosulphan	0.4
Beta Endosulphan	0.8
Alpha Chlordane	0.4
Gamma Chlordane	0.4
Lindane (gamma BHC)	0.4
Alpha BHC	0.4
Mirex	1.2
1,3-dichlorobenzene	3.0
1,3,5-trichlorobenzene	0.7
1,2,3,4, Tetra C.B.	0.2
Hexachloro Benzene	0.1
Chlorothalonil	0.8
Metribuzin	2.0
Atrazine	2.0
Guthion	0.8
Disulphoton	0.4
Malathion	0.4
Phorate	0.4
Phosmet (Imidan)	0.4
Azinophos-ethyl	0.8
Naphthalene	5.0
Acenaphthene	2.0
Phenanthrene	1.5
Anthracene	5.0
Fluoranthene	0.5
Pyrene	1.0
Benzo(A)Anthrasone	0.25
Chrysene	2.5
Benzo(b)Fluoranthene	0.3
Benzo(k)Fluoranthene	0.1
Benzo(a)Pyrene	0.25

Spiking Solutions: Quidi Vidi Survey 1990

	Concentration $\mu g/L$
1,2,4,5-TeCB	0.75
1,2,3,4-TeCB	0.5
Hexachlorobenzene	0.25
Pentachlorobenzene	0.25
Total arochlors	30 $ng/\mu L$

FIGURE 1
ROADSALT (NaCl) USAGE IN ST JOHN'S AND MOUNT PEARL
BETWEEN 1985 TO 1992 (TONNES)

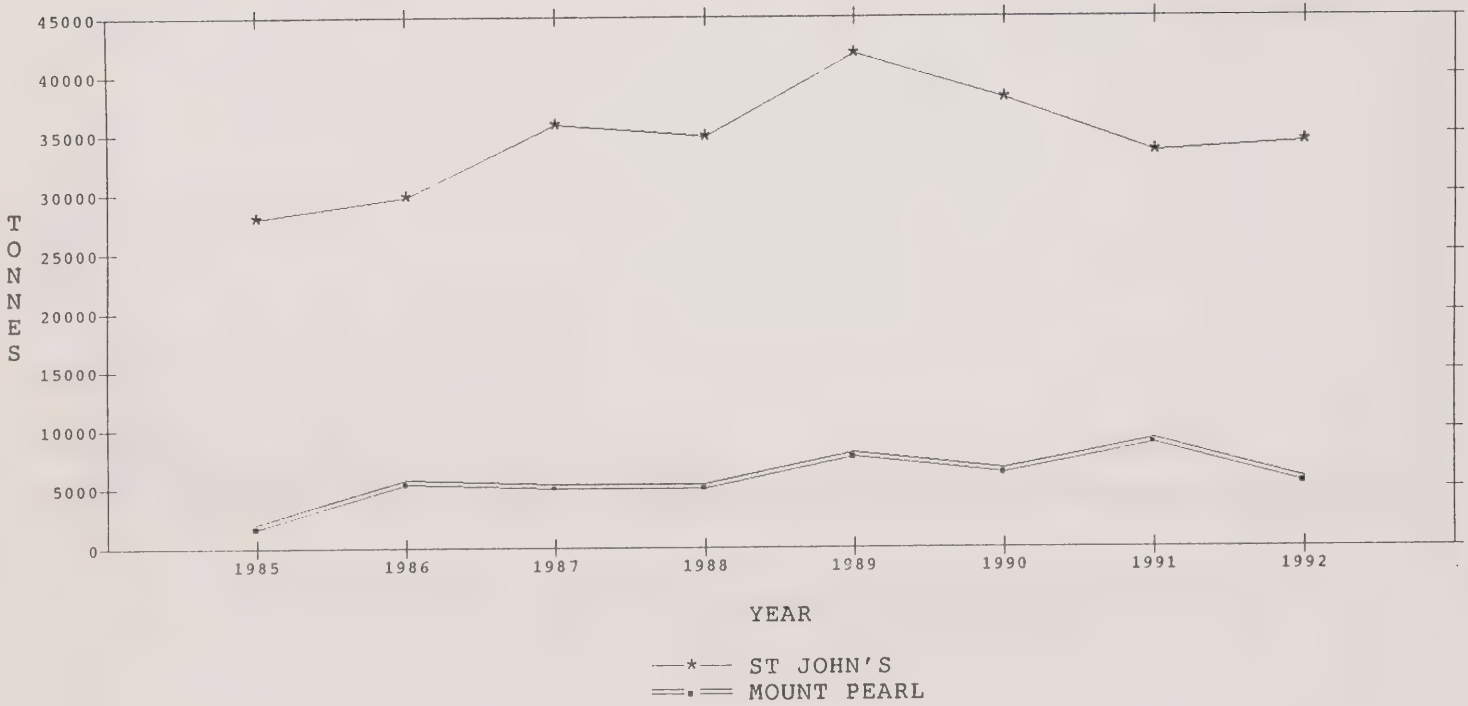


FIGURE 2

DAILY DISCHARGE (CMS) AT THREE HYDROMETRIC GAUGE STATIONS LOCATED IN THE WATERFORD RIVER BASIN BETWEEN AUGUST 06 TO 20, 1989

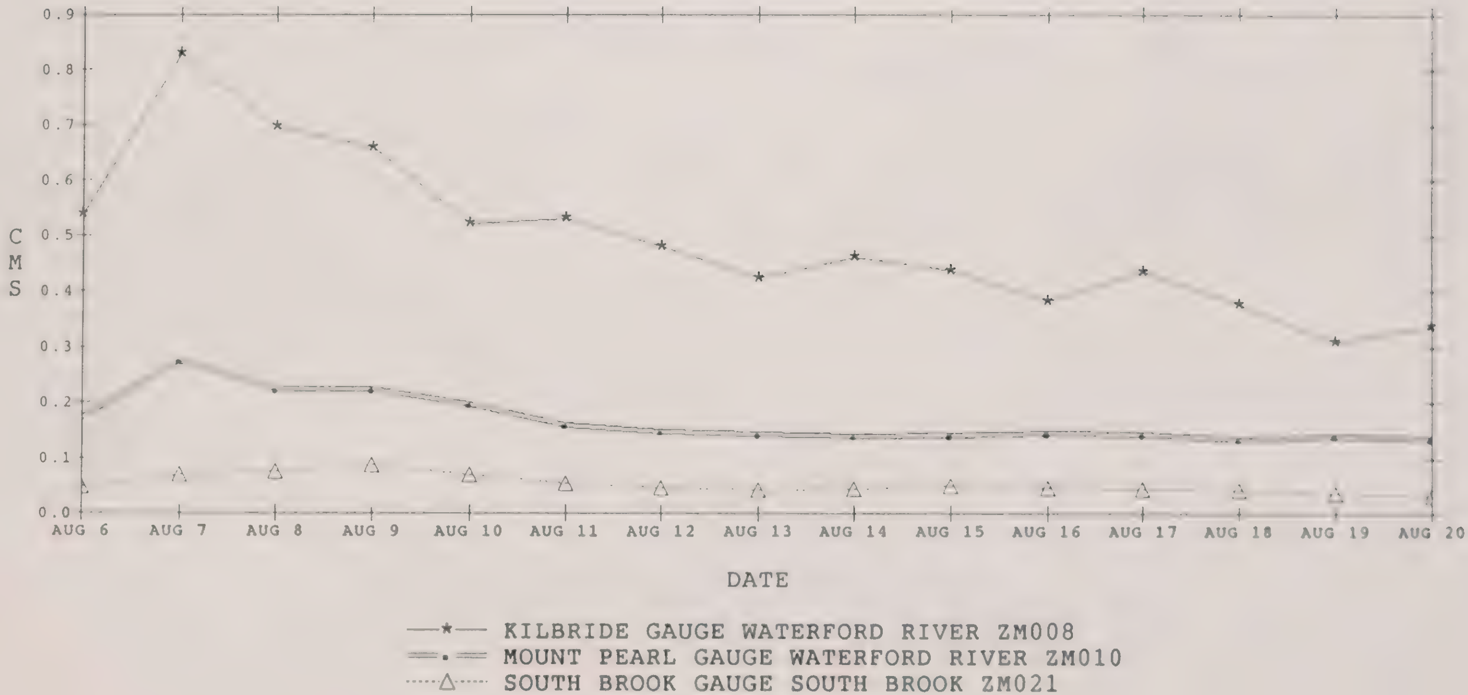


FIGURE 3
DAILY DISCHARGE (CMS) AT THREE HYDROMETRIC GAUGE STATIONS LOCATED IN THE WATERFORD RIVER BASIN DURING 1989

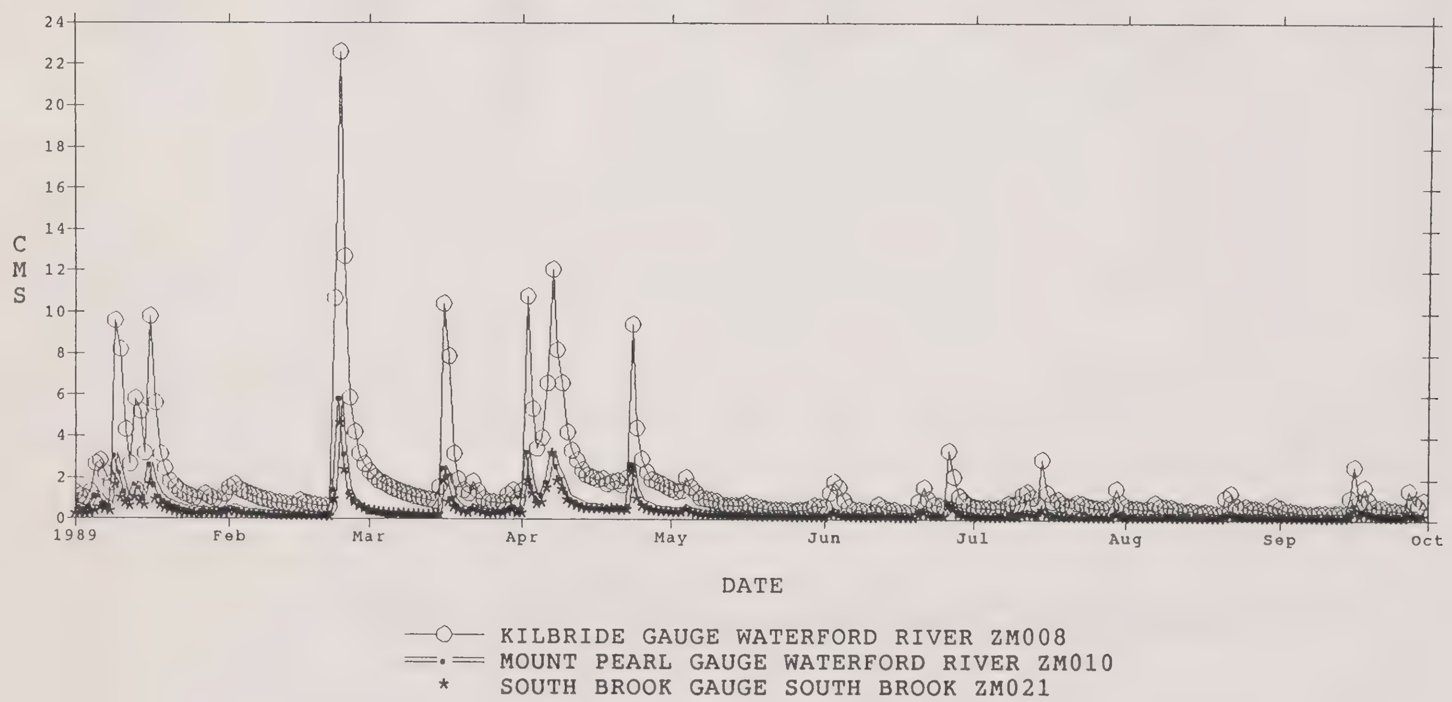


FIGURE 4
DAILY MEAN DISCHARGE (CMS) AT THE HYDROMETRIC GAUGE STATION
(ZM008) ON THE WATERFORD RIVER BETWEEN 1986 TO 1989

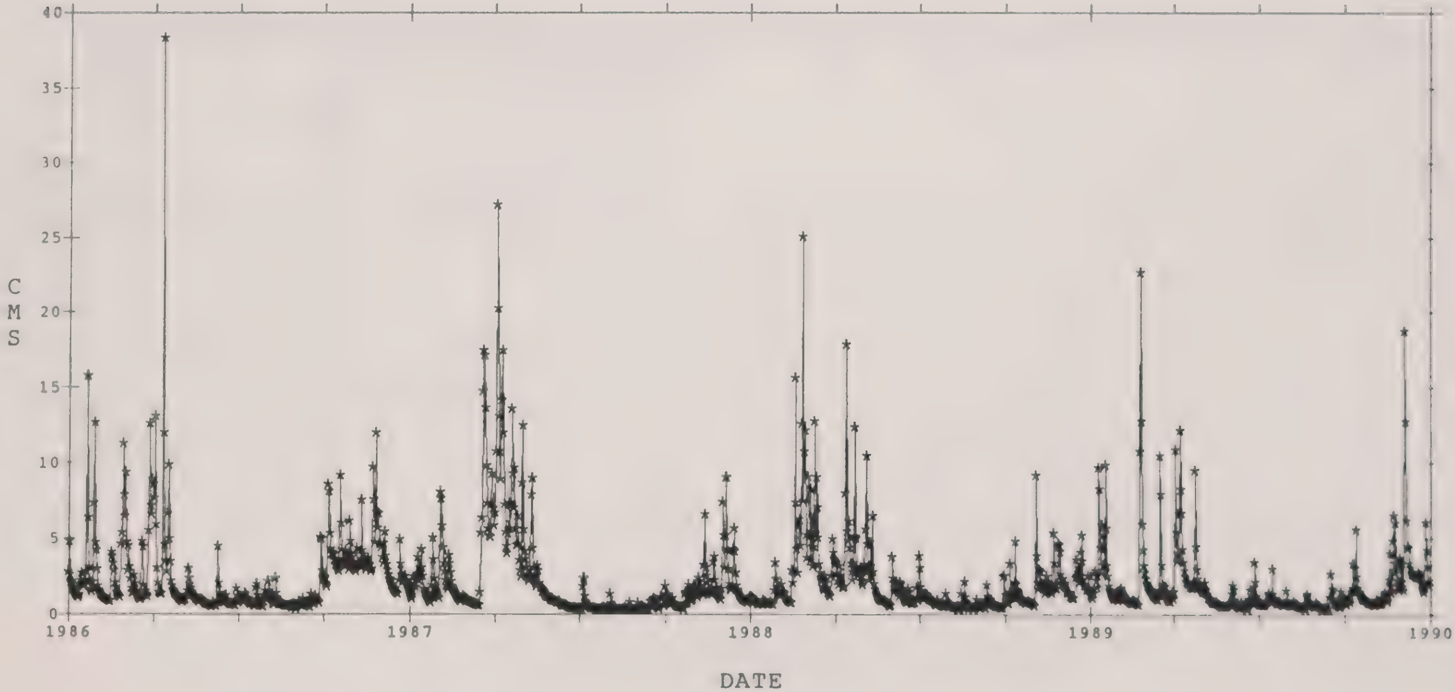


FIGURE 5
DAILY DISCHARGE (CMS) AT THREE HYDROMETRIC GAUGE STATIONS LOCATED IN THE QUIDI VIDI BASIN BETWEEN AUGUST 06 TO 17, 1990

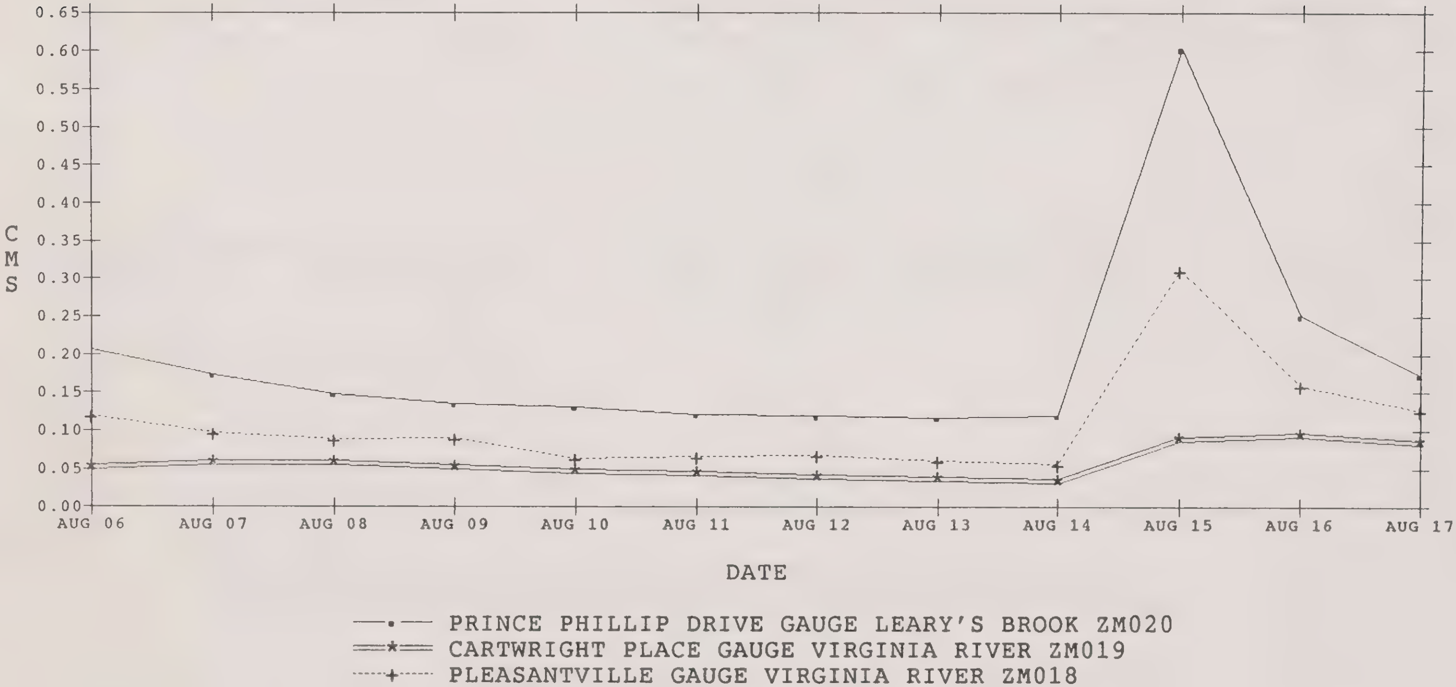


FIGURE 6
DAILY MEAN DISCHARGE (CMS) AT TWO HYDROMETRIC GAUGE STATIONS LOCATED IN THE QUIDI VIDI BASIN BETWEEN 1986 TO 1990

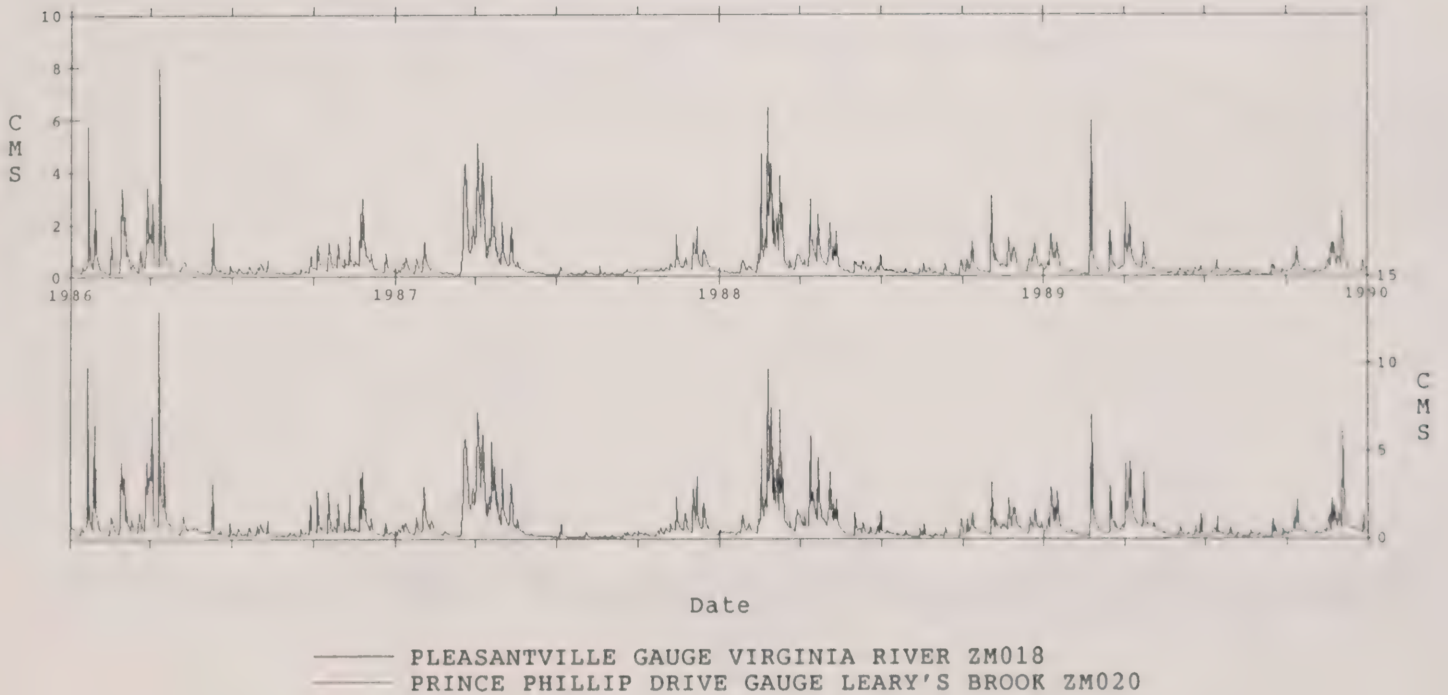
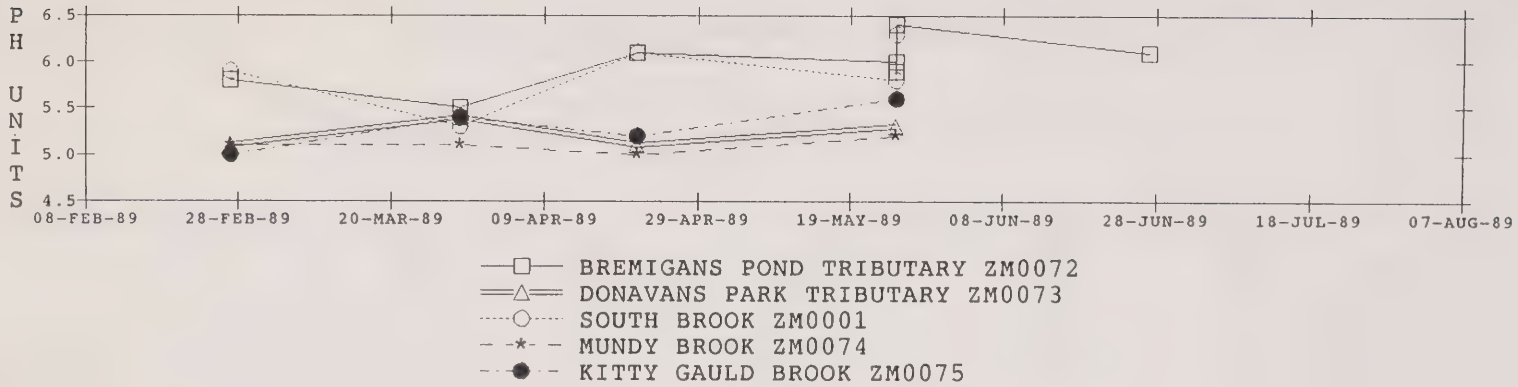


FIGURE 7
PH CONCENTRATION (PH UNITS) AND SPECIFIC CONDUCTANCE (USIE/CM)
AT FIVE HEADWATER SITES SAMPLED BETWEEN FEBRUARY TO AUGUST 1989



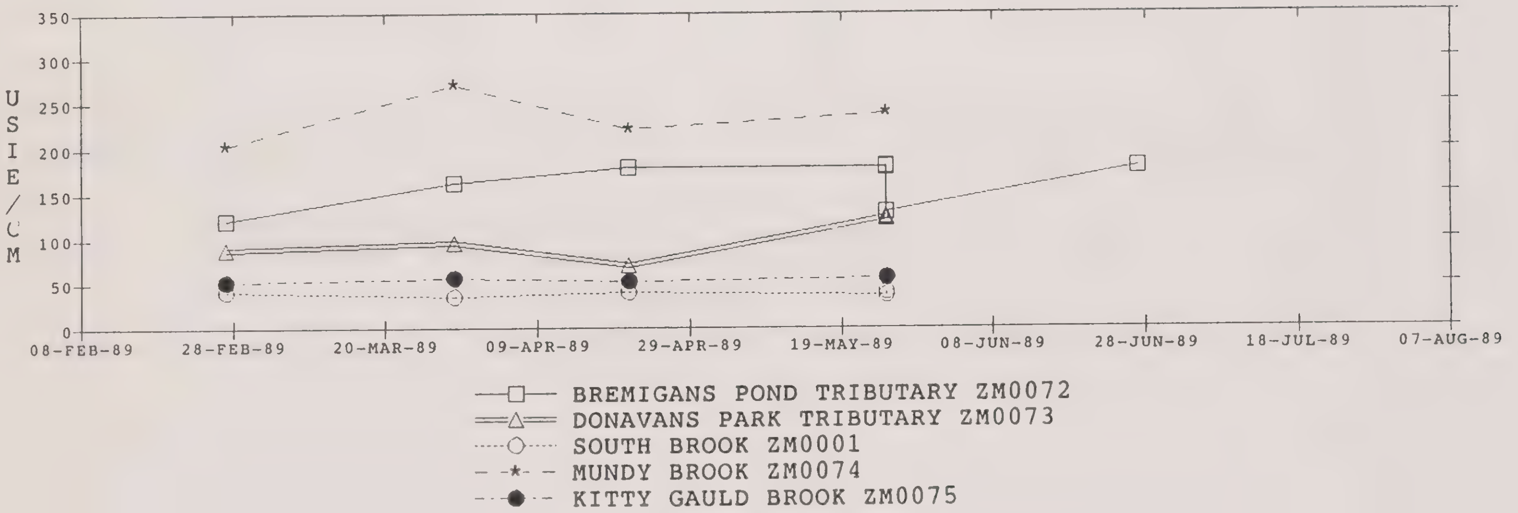


FIGURE 8
DISSOLVED ORGANIC CARBON AND GEOLOGICAL METALS AT FIVE HEADWATER SITES SAMPLED BETWEEN FEBRUARY TO AUGUST 1989 (MG/L)

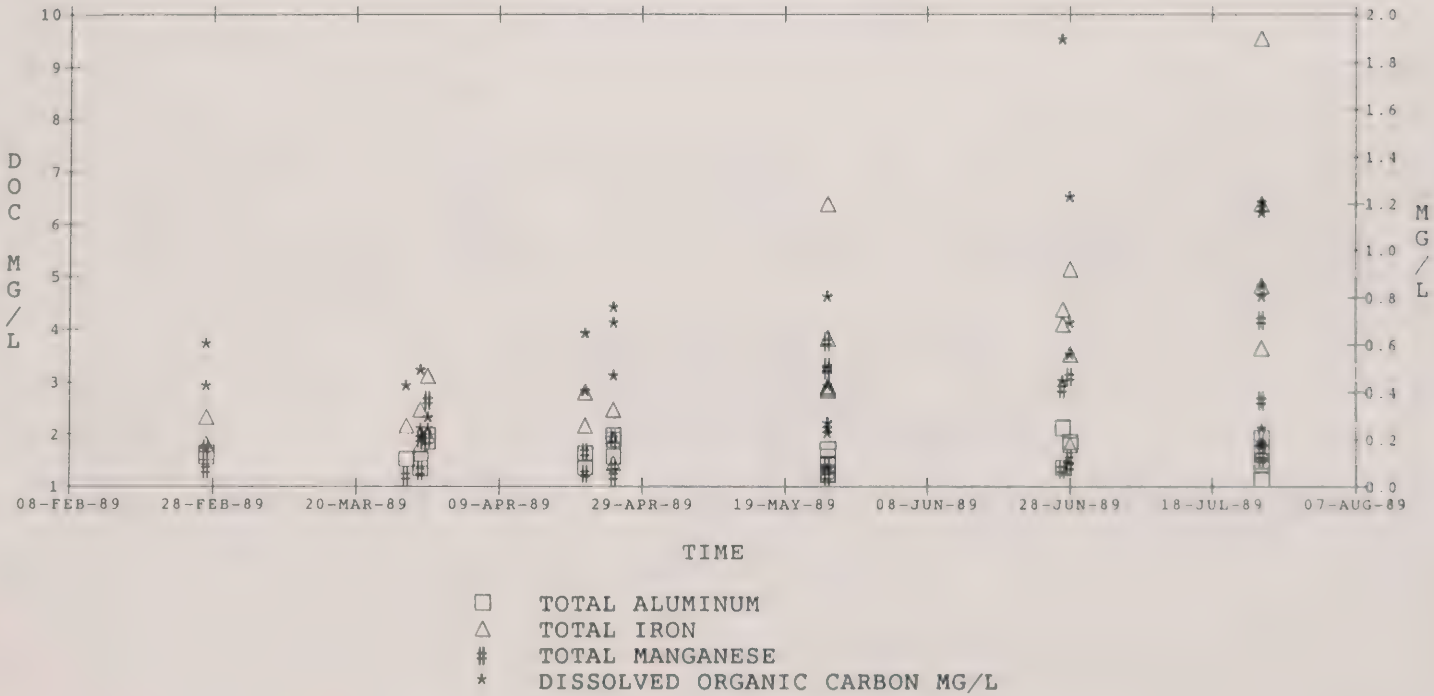


FIGURE 9
TOTAL ALKALINITY AND THE RATIO OF DISSOLVED SULPHATE TO CHLORIDE AT HEADWATER SITES SAMPLED BETWEEN FEBRUARY TO AUGUST 1989

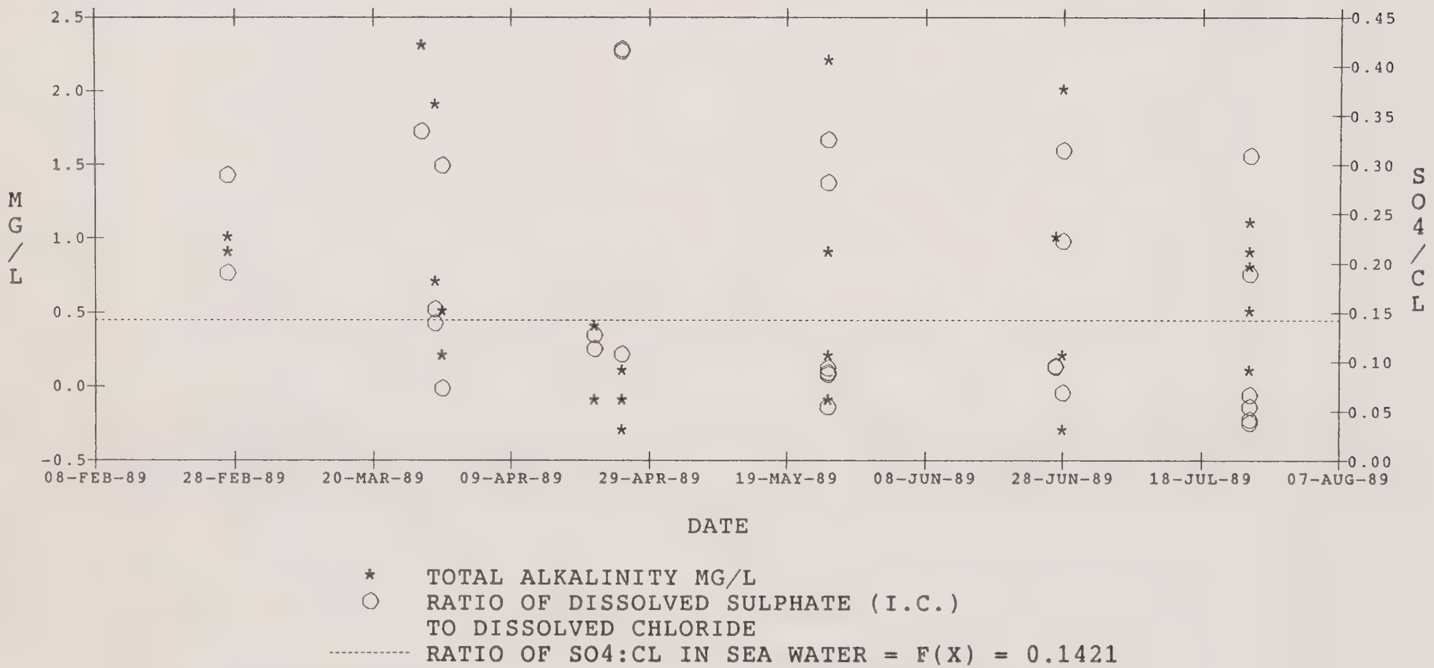
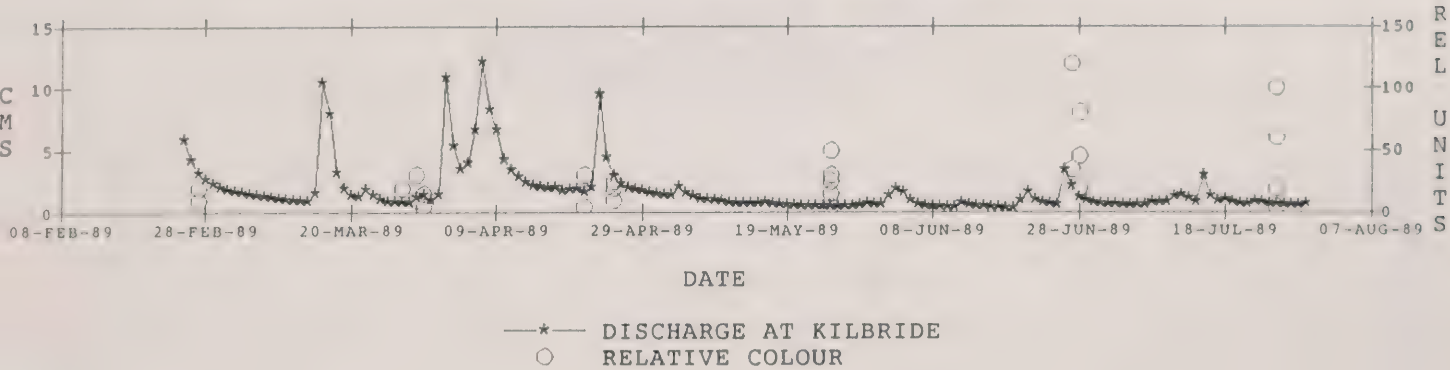


FIGURE 10
COLOUR (RELATIVE UNITS) AND TURBIDITY (JT UNITS) AT FIVE HEADWATER SITES IN RELATION TO DAILY DISCHARGE AT THE KILBRIDE HYDROMETRIC GUAGE (ZM008) ON THE WATERFORD RIVER



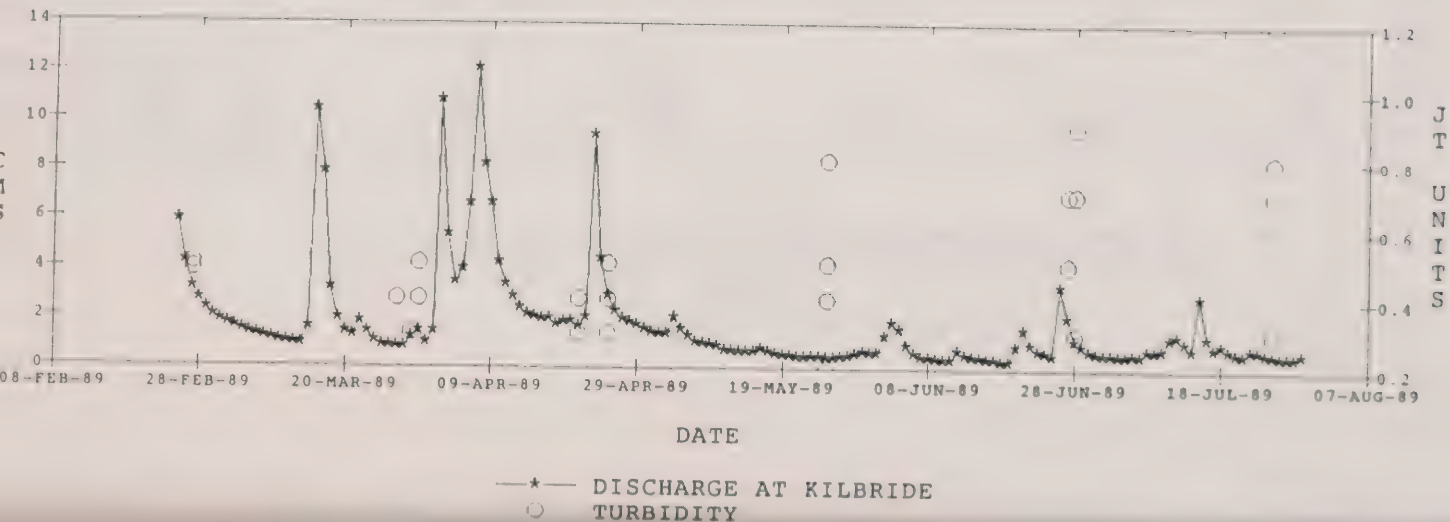


FIGURE 11
THE TEMPORAL RELATIONSHIP OF APPARENT COLOUR TO TURBIDITY TO DISSOLVED ORGANIC CARBON AT THE KILBRIDE WATER QUALITY STATION (ZM0009) BETWEEN 1986 TO 1989

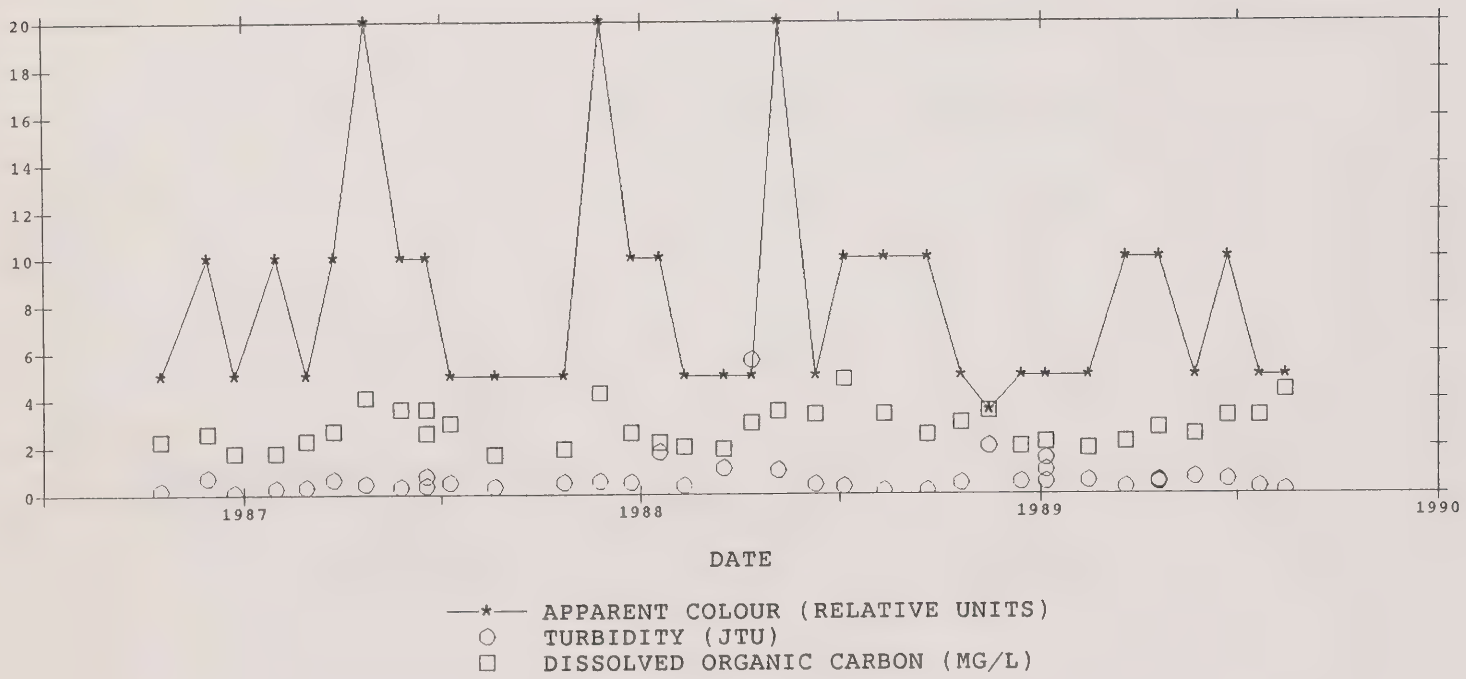
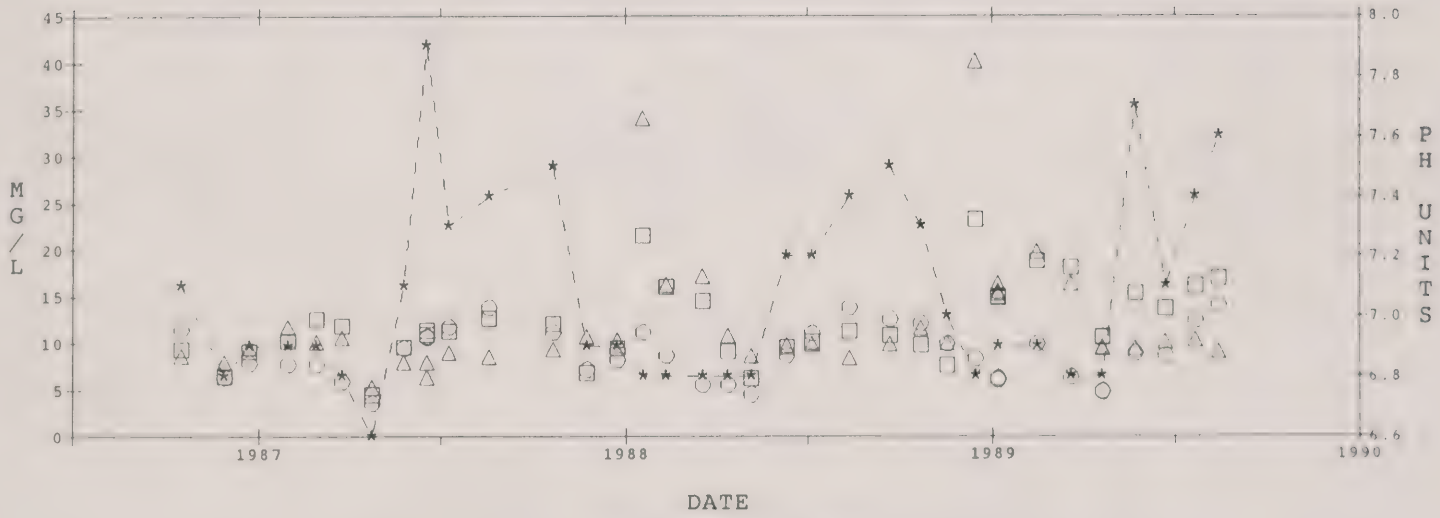


FIGURE 12
THE TEMPORAL RELATIONSHIP OF PH TO TOTAL ALKALINITY TO DISSOLVED CALCIUM AND SULPHATE (I.C.) AT THE KILBRIDE WATER QUALITY STATION (ZM0009) BETWEEN 1986 TO 1989



○ TOTAL ALKALINITY (MG/L)
□ DISSOLVED CALCIUM (MG/L)
- -★- - PH LABORATORY (PH UNITS)
△ DISSOLVED SULPHATE I.C. (MG/L)

FIGURE 13
THE TEMPORAL RELATIONSHIP OF SPECIFIC CONDUCTANCE TO SODIUM AND CHLORIDE AT THE KILBRIDE WATER QUALITY STATION (ZM0009) BETWEEN 1981 TO 1992

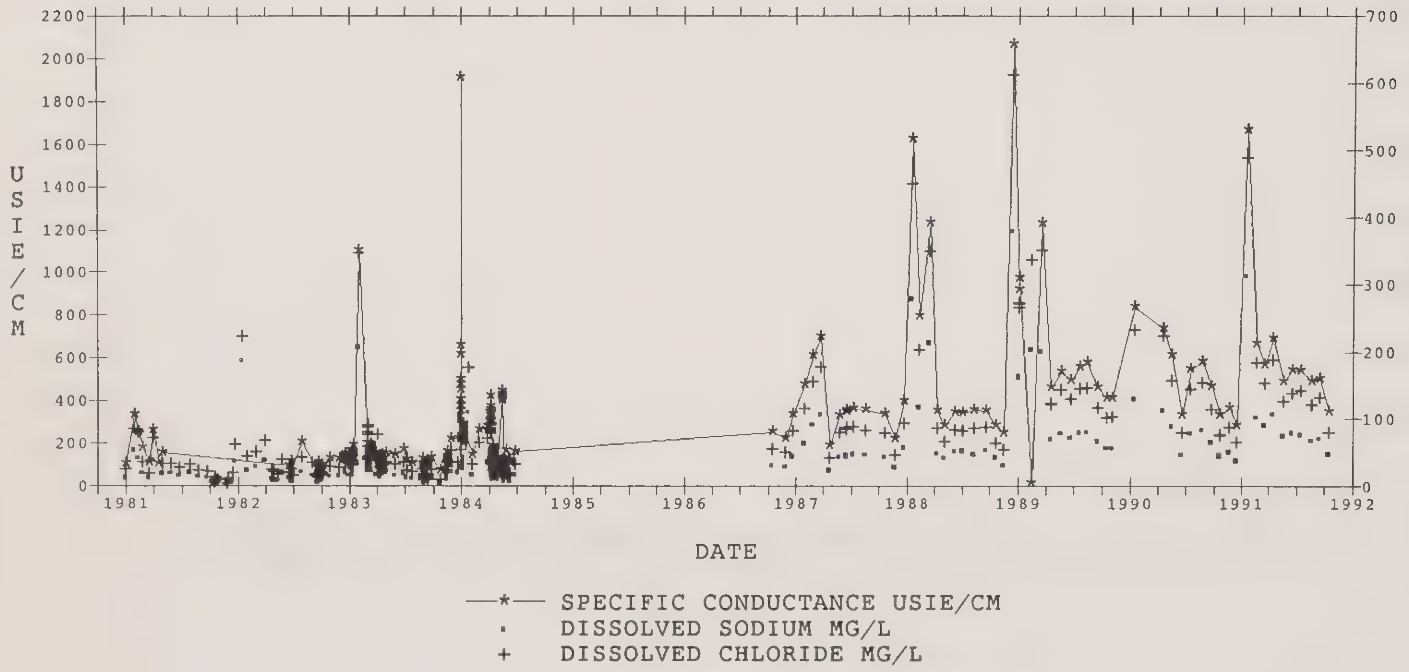


FIGURE 14
HEAVY METALS IN RELATION TO WATER QUALITY GUIDELINE FOR THE PROTECTION OF AQUATIC LIFE AT STATIONS ON OR ADJACENT TO THE WATERFORD RIVER FOR STATIONS WITH A GREATER THAN GUIDELINE VALUE

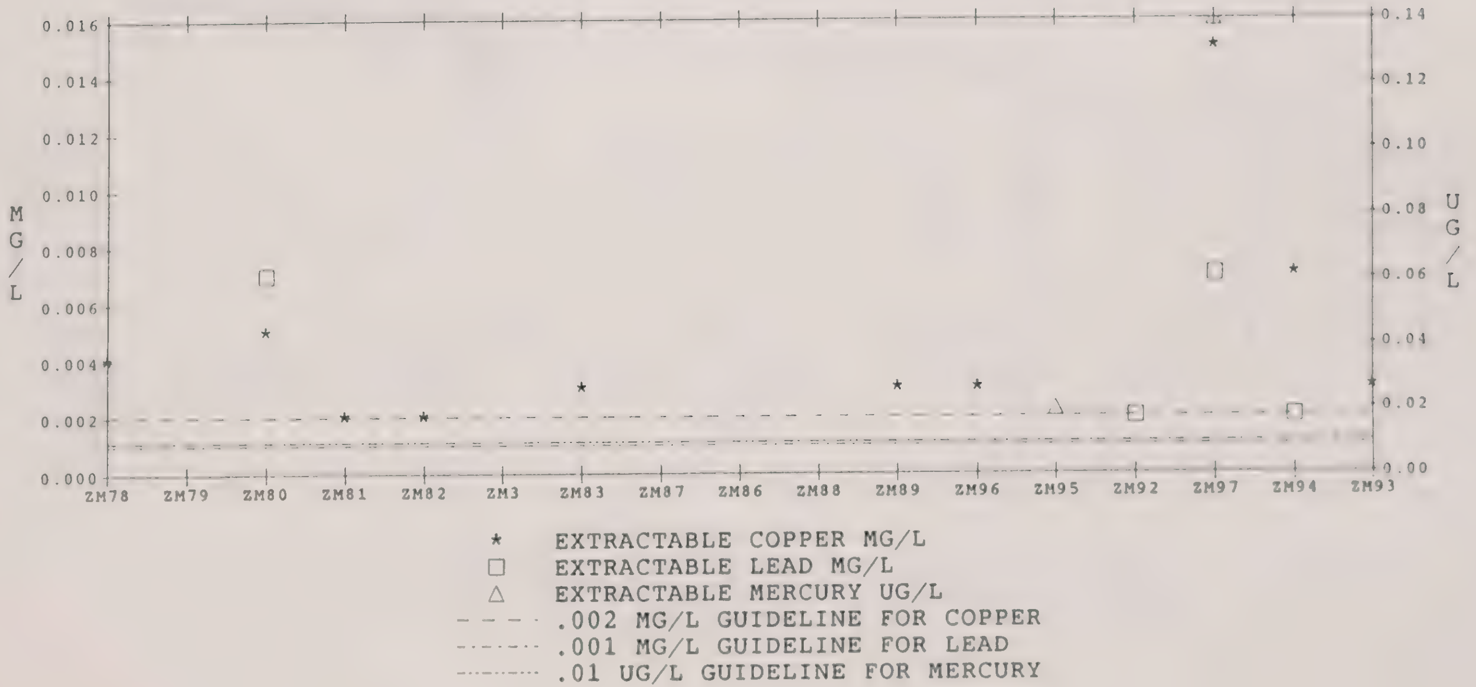


FIGURE 15

HEAVY METALS IN RELATION TO WATER QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE AT STATIONS ON OR ADJACENT TO THE WATERFORD RIVER FOR STATIONS WITH A GREATER THAN GUIDELINE VALUE

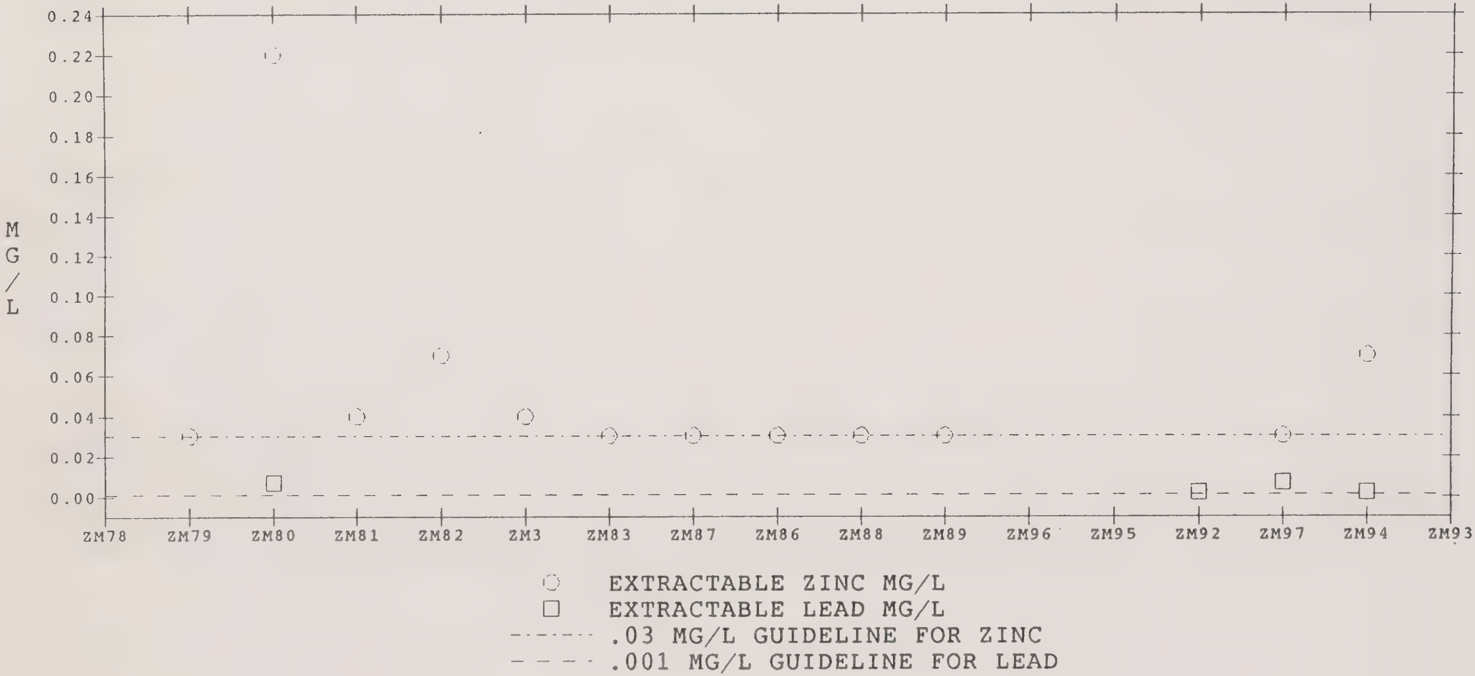


FIGURE 16

GEOLOGICAL METALS (MG/L) AND LABORATORY PH (PH UNITS) AT STATIONS ON OR ADJACENT TO THE WATERFORD RIVER

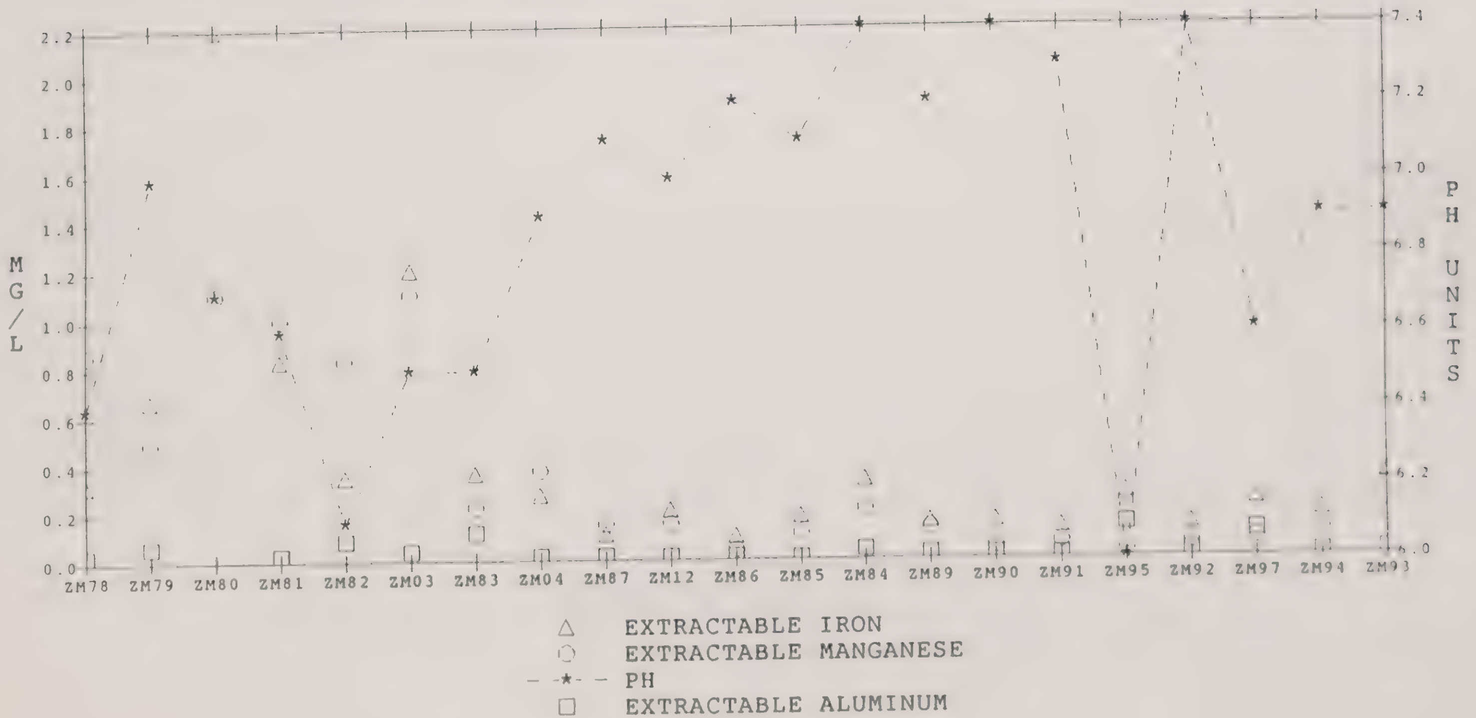


FIGURE 17
PH (PH UNITS) IN RELATION TO ALKALINITY AND DISSOLVED SULPHATE (MG/L) AT STATIONS ON OR ADJACENT TO THE WATERFORD RIVER

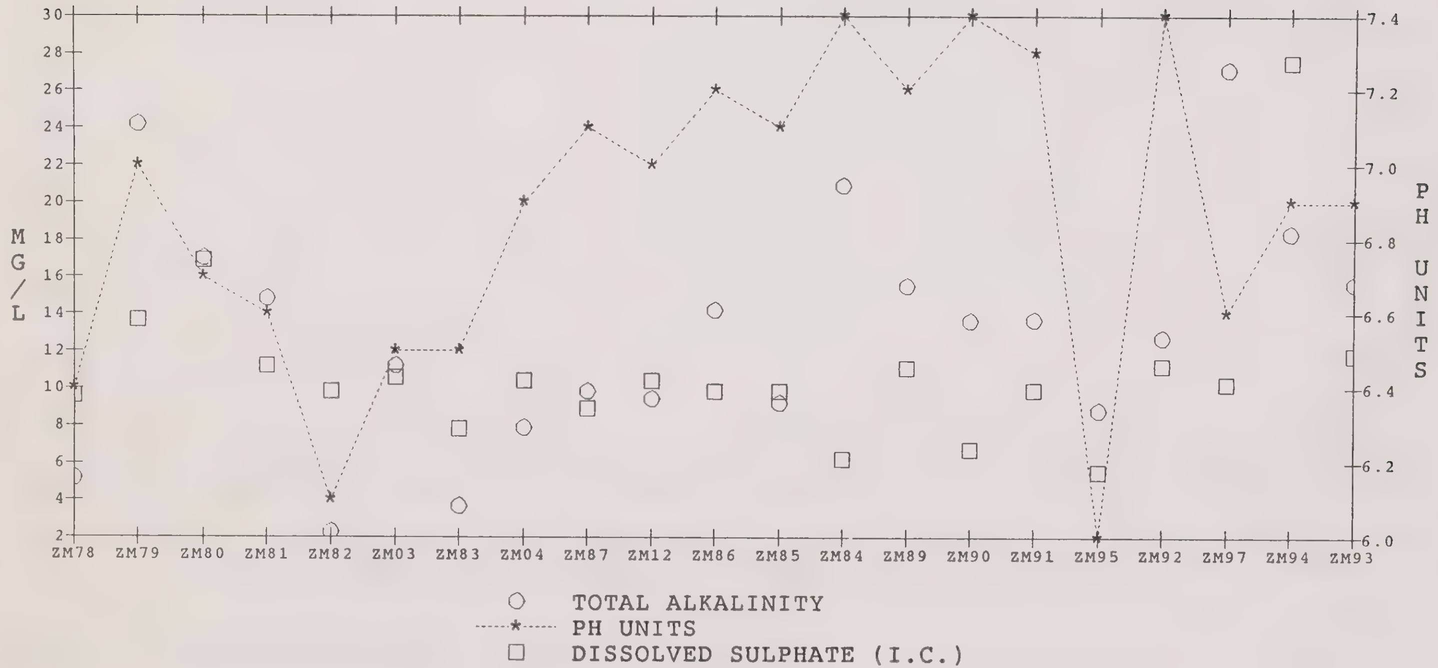


FIGURE 18
MAJOR IONS (MG/L) AND SPECIFIC CONDUCTANCE (USIE/CM) AT
STATIONS ON OR ADJACENT TO THE WATERFORD RIVER

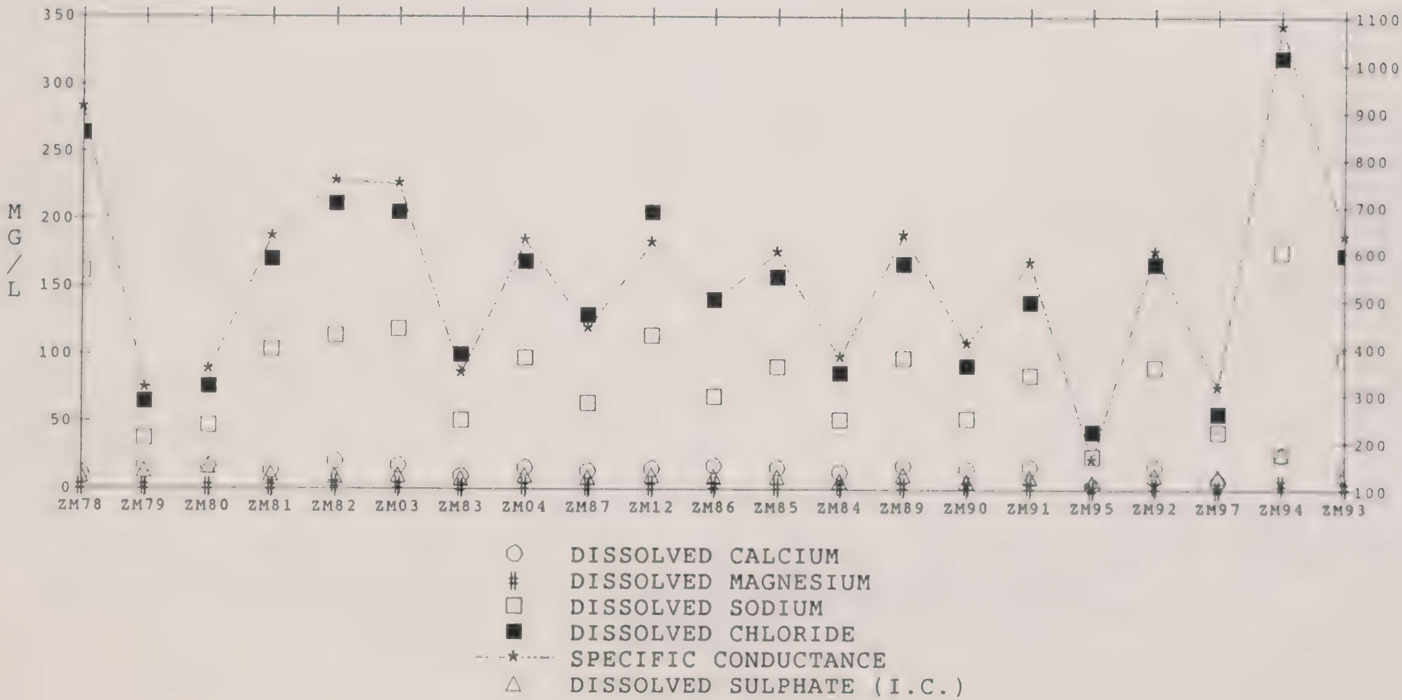
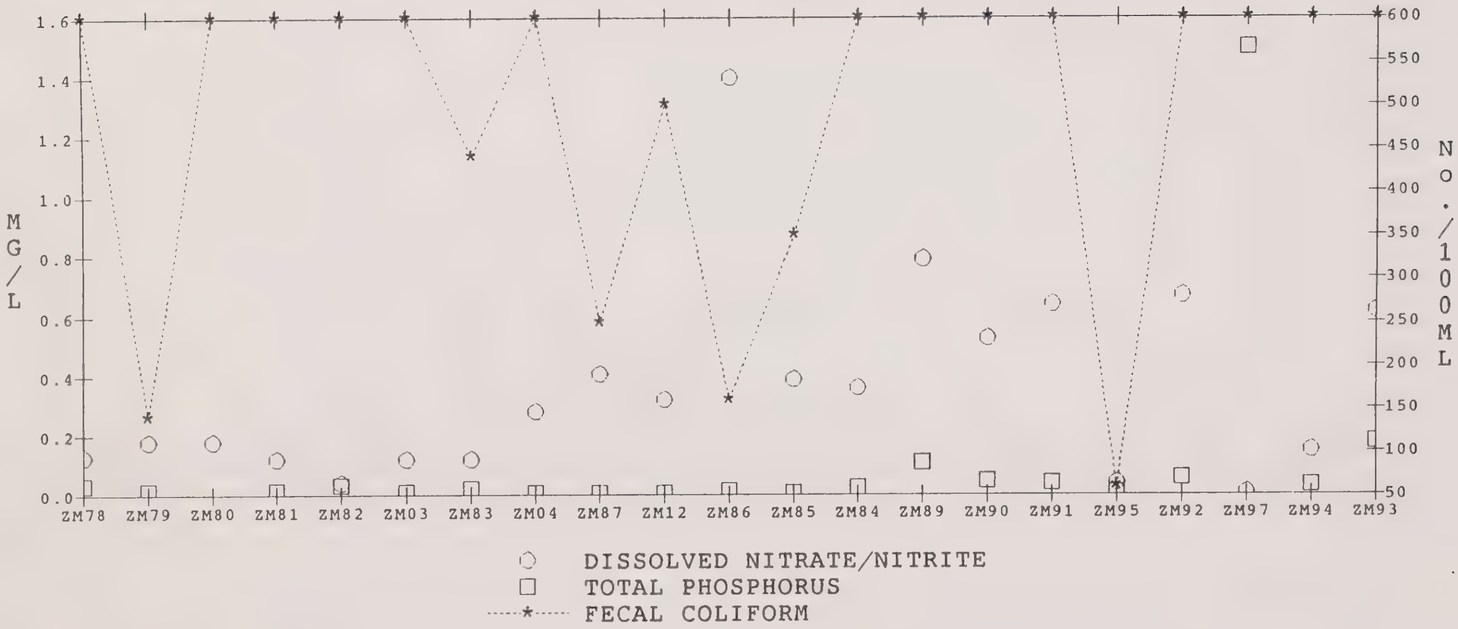


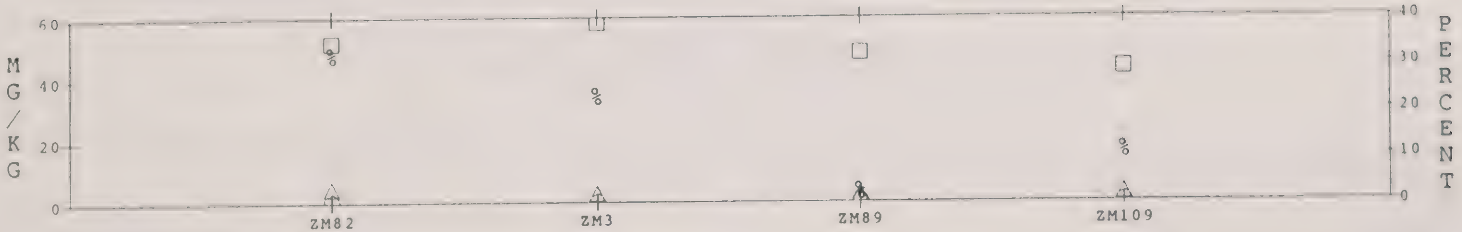
FIGURE 19

FECAL COLIFORM COUNTS (No./100ml sample) AND NUTRIENTS (MG/L) AT STATIONS ON OR ADJACENT TO THE WATERFORD RIVER



FECAL COLIFORM MAXIMUM COUNT OF 600/100 ML SAMPLE
REPRESENT VALUES GREATER THAN 600/100 ML SAMPLE

FIGURE 20
HEAVY METAL CONCENTRATION (MG/KG) AND PERCENT LIPID BODY WEIGHT (%) OF FORAGE FISH SAMPLES COLLECTED WITHIN THE WATERFORD RIVER BASIN BETWEEN AUGUST 06 TO 20,1990



□ TOTAL ZINC
○ TOTAL LEAD
△ TOTAL COPPER
% LIPID (PERCENT BODY WEIGHT)

* TOTAL MERCURY
TOTAL CADMIUM
□ TOTAL CHROMIUM
△ TOTAL NICKEL
• TOTAL LEAD
% LIPID (PERCENT BODY WEIGHT)

FIGURE 21
HEAVY METALS (MG/L) AT THE KILBRIDE WATER QUALITY STATION (ZM0009) IN RELATION TO THE MEAN DAILY DISCHARGE AT THE KILBRIDE HYDROMETRIC GUAGE (ZM008) OVER THE PERIOD OF 1986 TO 1889

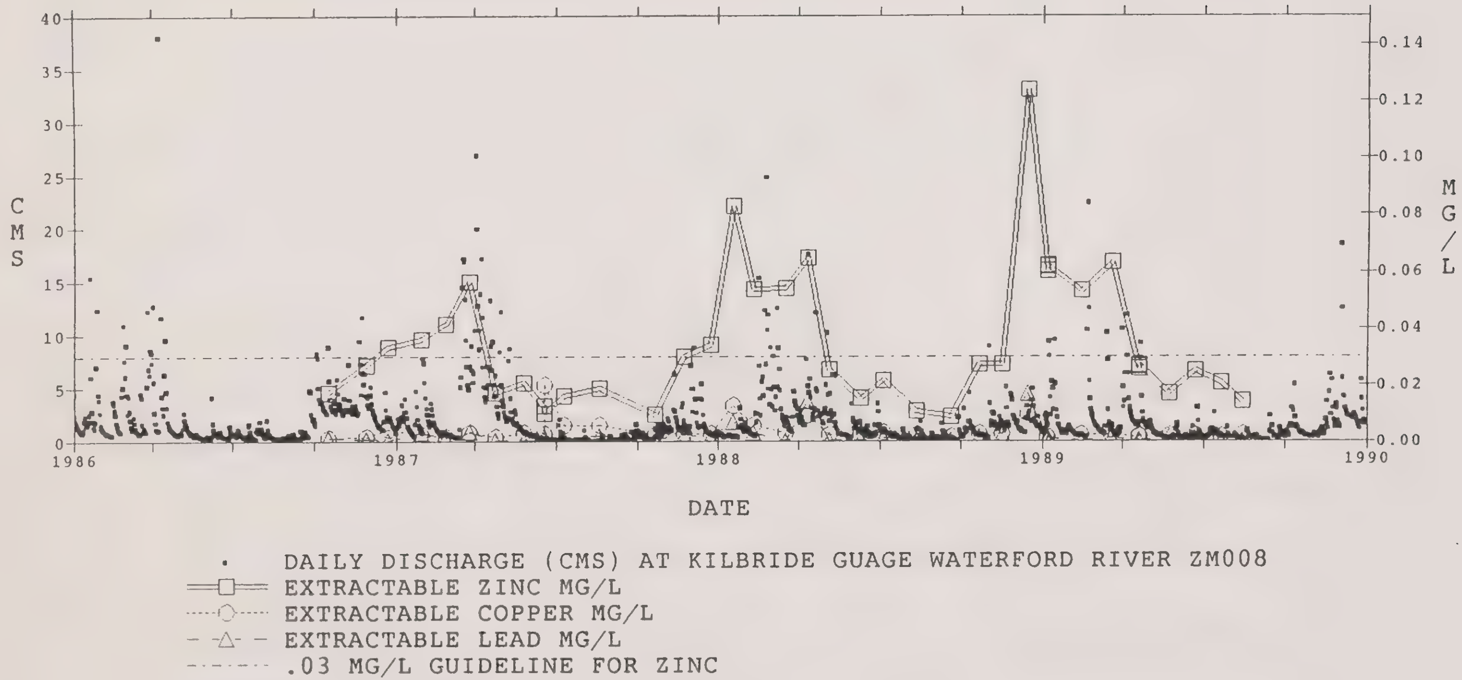


FIGURE 22
HEAVY METAL CONCENTRATIONS (MG/KG) IN RELATION TO THE REFERENCE ELEMENT ALUMINUM (MG/KG) COLLECTED WITHIN THE WATERFORD RIVER BASIN BETWEEN AUGUST 06 TO 20,1989

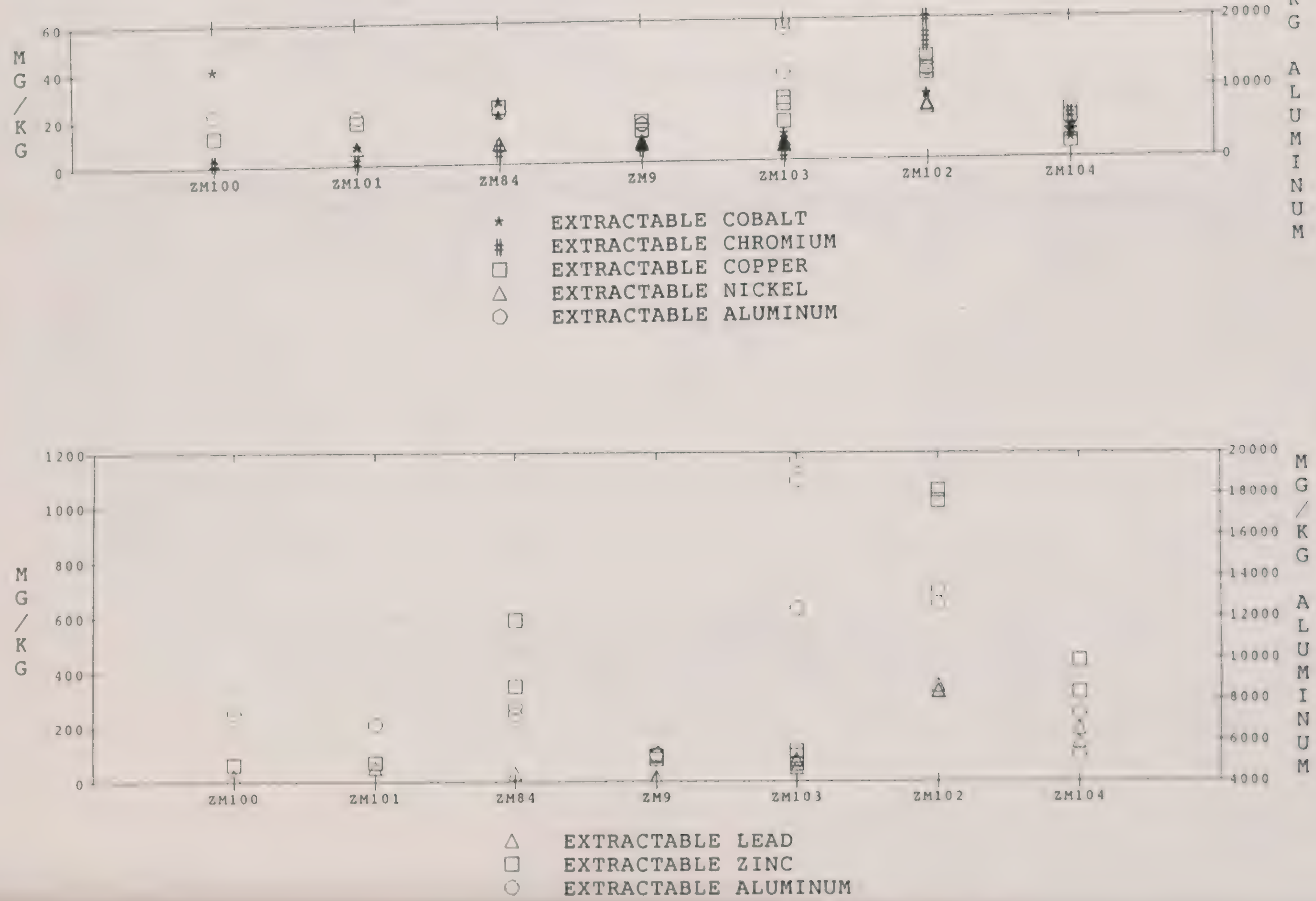


FIGURE 23
PH CONCENTRATION (PH UNITS) AT FOUR HEADWATER SITES SAMPLED
BETWEEN APRIL TO AUGUST 1990

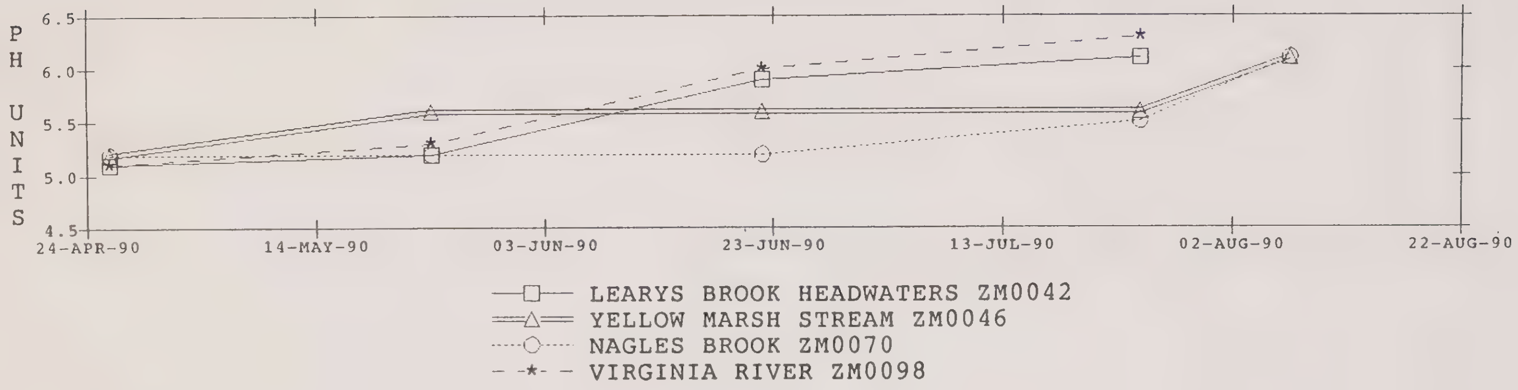


FIGURE 24
SPECIFIC CONDUCTANCE (USIE/CM) AT FOUR HEADWATER SITES SAMPLED
BETWEEN APRIL TO AUGUST 1990

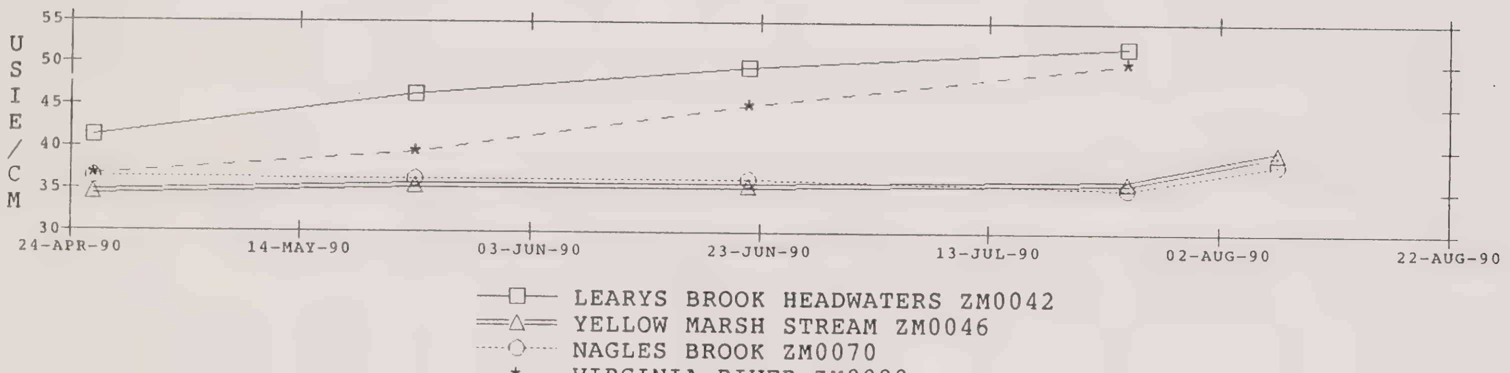


FIGURE 25
DISSOLVED ORGANIC CARBON AND GEOLOGICAL METALS AT FOUR HEADWATER SITES SAMPLED BETWEEN APRIL AND AUGUST 1990 IN THE QUIDI VIDI BASIN

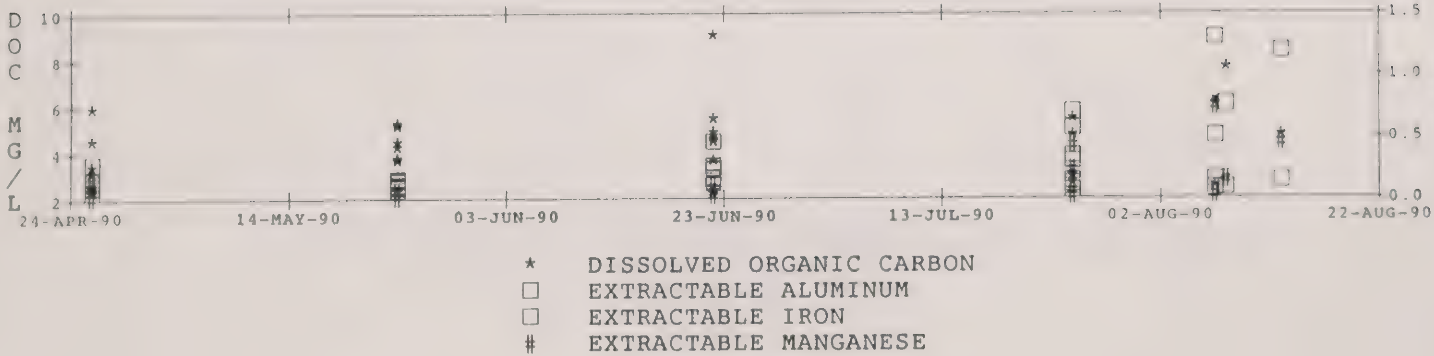


FIGURE 26
SELECTED MAJOR IONS AND TOTAL ALKALINITY AT FOUR HEADWATER SITES SAMPLED BETWEEN APRIL AND AUGUST 1990

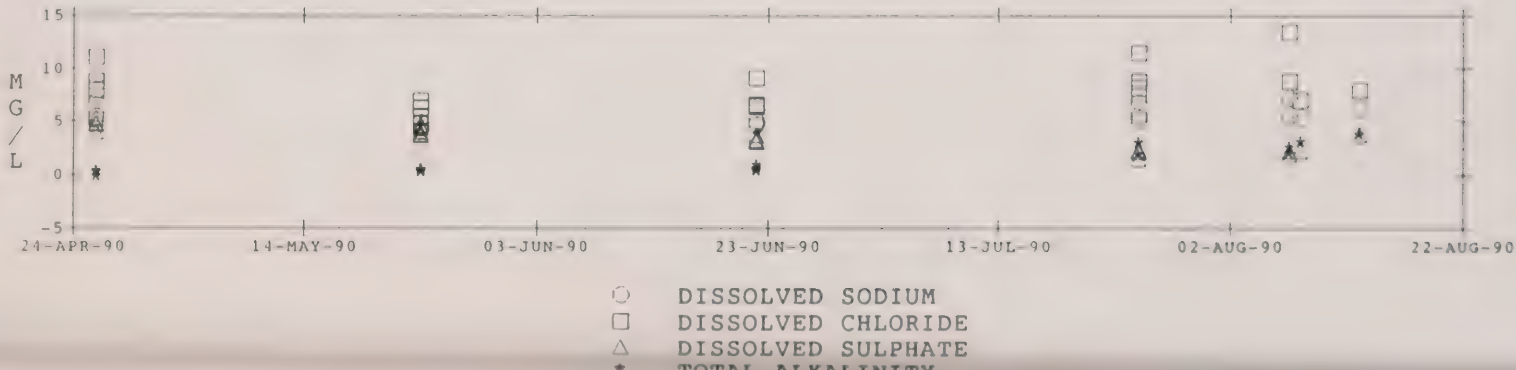


FIGURE 27
COLOUR (RELATIVE UNITS) AND TURBIDITY (JT UNITS) AT FOUR HEADWATER SITES IN THE QUIDI VIDI BASIN SAMPLED BETWEEN APRIL AND AUGUST 1990

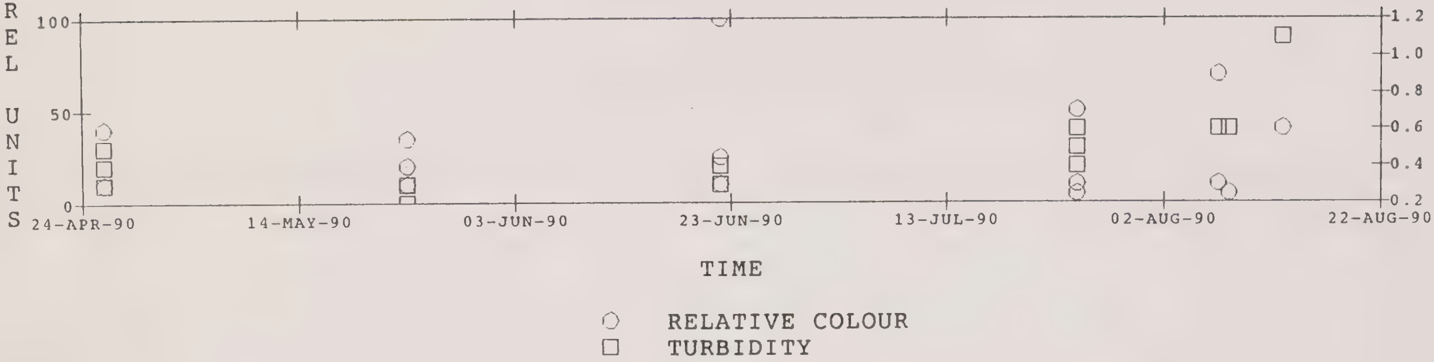
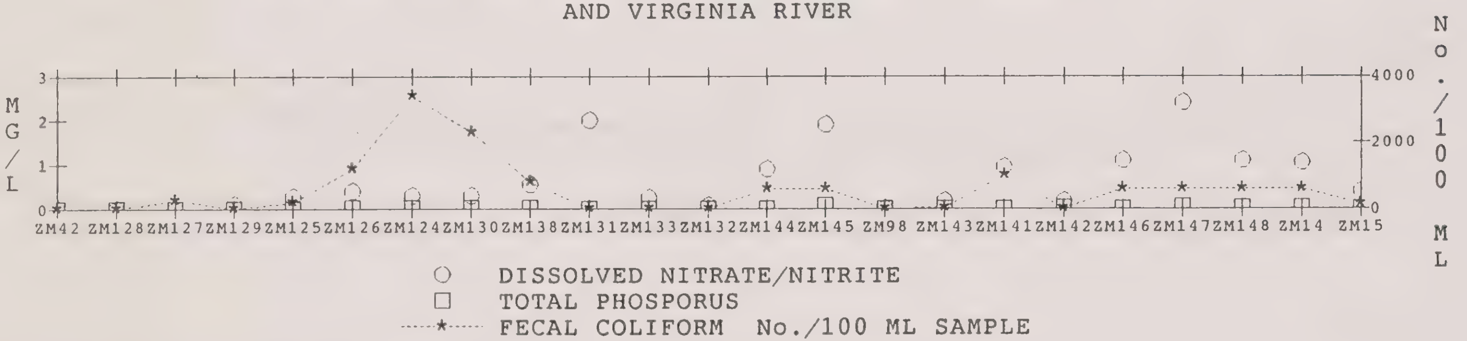


FIGURE 28
FECAL COLIFORM COUNTS (N0./100ml sample) AND NUTRIENTS (MG/L) AT STATIONS ON OR ADJACENT TO LEARY'S/RENNIES RIVER AND VIRGINIA RIVER



FECAL COLIFORM MAXIMUM COUNT OF 600/100 ML SAMPLE
REPRESENTS VALUES GREATER THAN 600/100 ML SAMPLE

FIGURE 29
MAJOR IONS (MG/L) AND SPECIFIC CONDUCTANCE (USIE/CM) AT STATIONS ON OR ADJACENT TO LEARY'S/RENNIES RIVER AND VIRGINIA RIVER

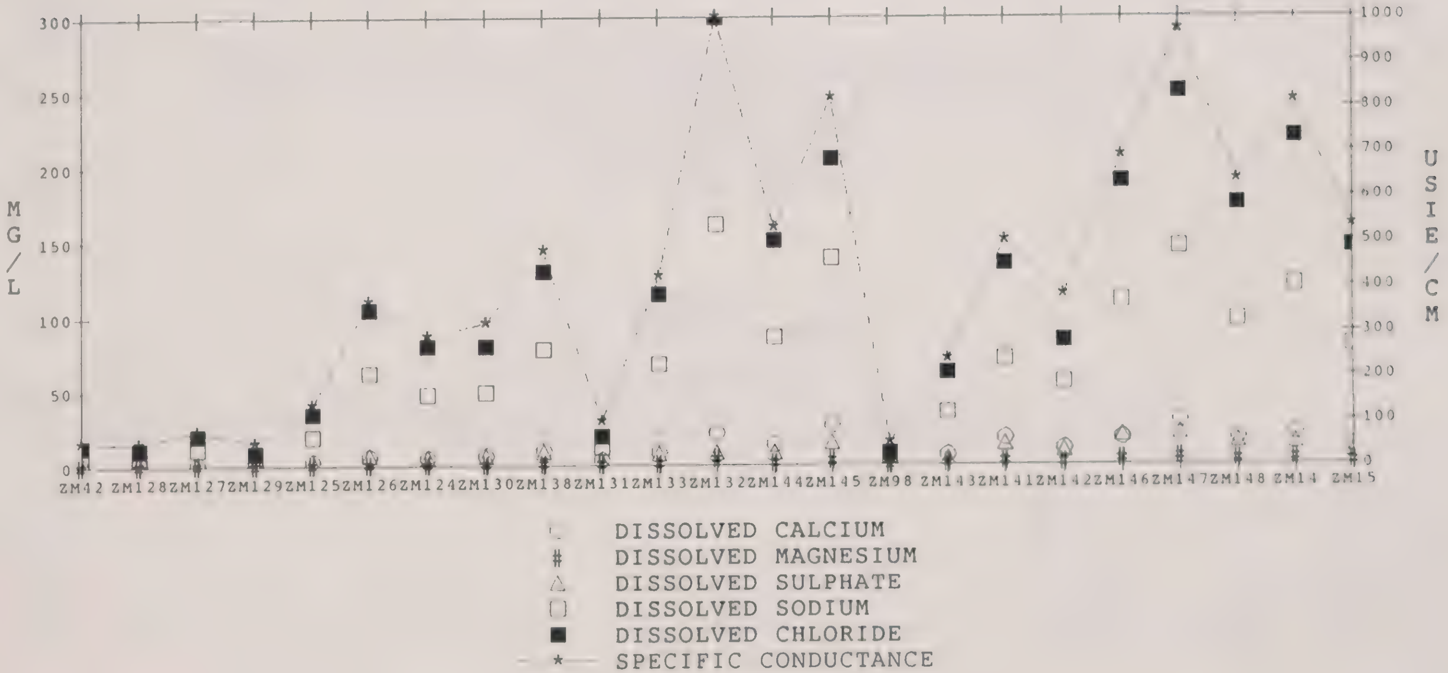


FIGURE 30
PH (PH UNITS) IN RELATION TO ALKALINITY AND DISSOLVED SULPHATE (MG/L) AT STATIONS ON OR ADJACENT TO LEARY'S/RENNIES RIVER AND VIRGINIA RIVER

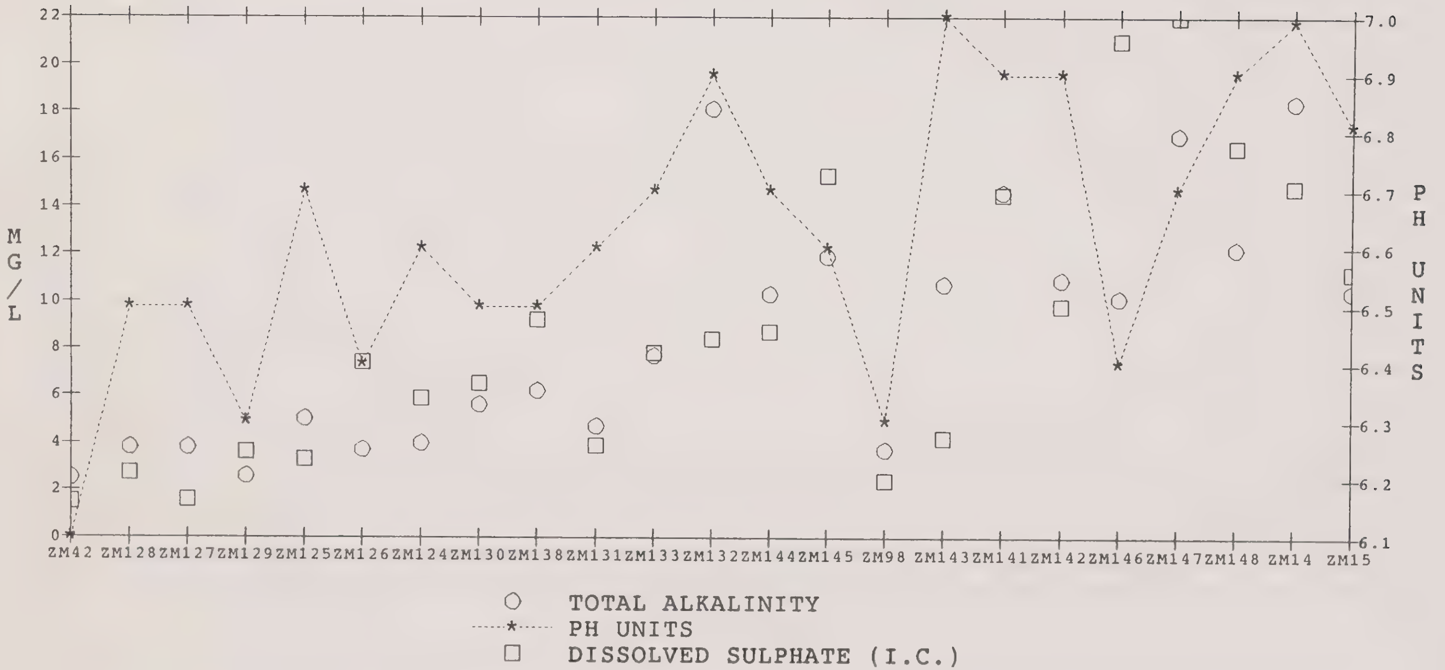


FIGURE 31
GEOLOGICAL METALS (MG/L) AND LABORATORY PH (PH UNITS) AT STATIONS ON OR ADJACENT TO LEARY'S/RENNIES RIVER AND VIRGINIA RIVER

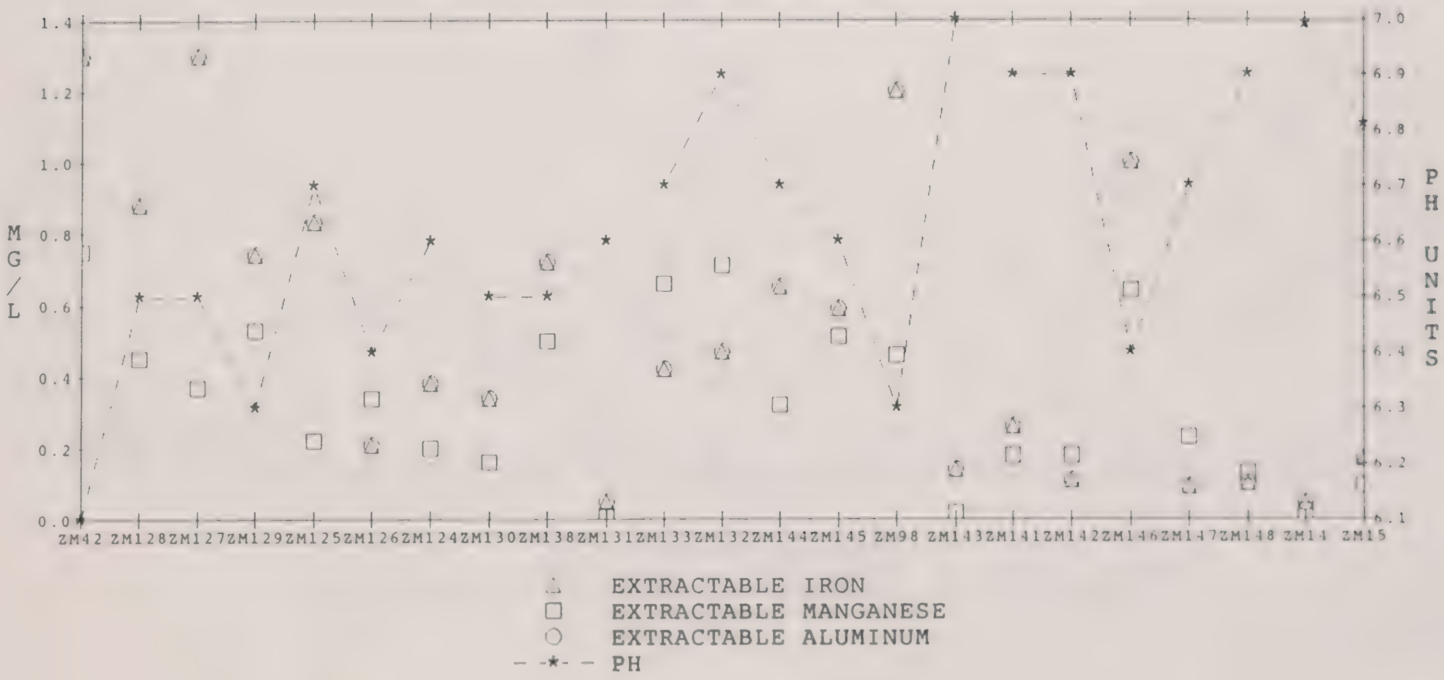


FIGURE 32
HEAVY METALS IN RELATION TO WATER QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE AT STATIONS ON OR ADJACENT TO LEARY'S/RENNIES RIVER AND VIRGINIA RIVER

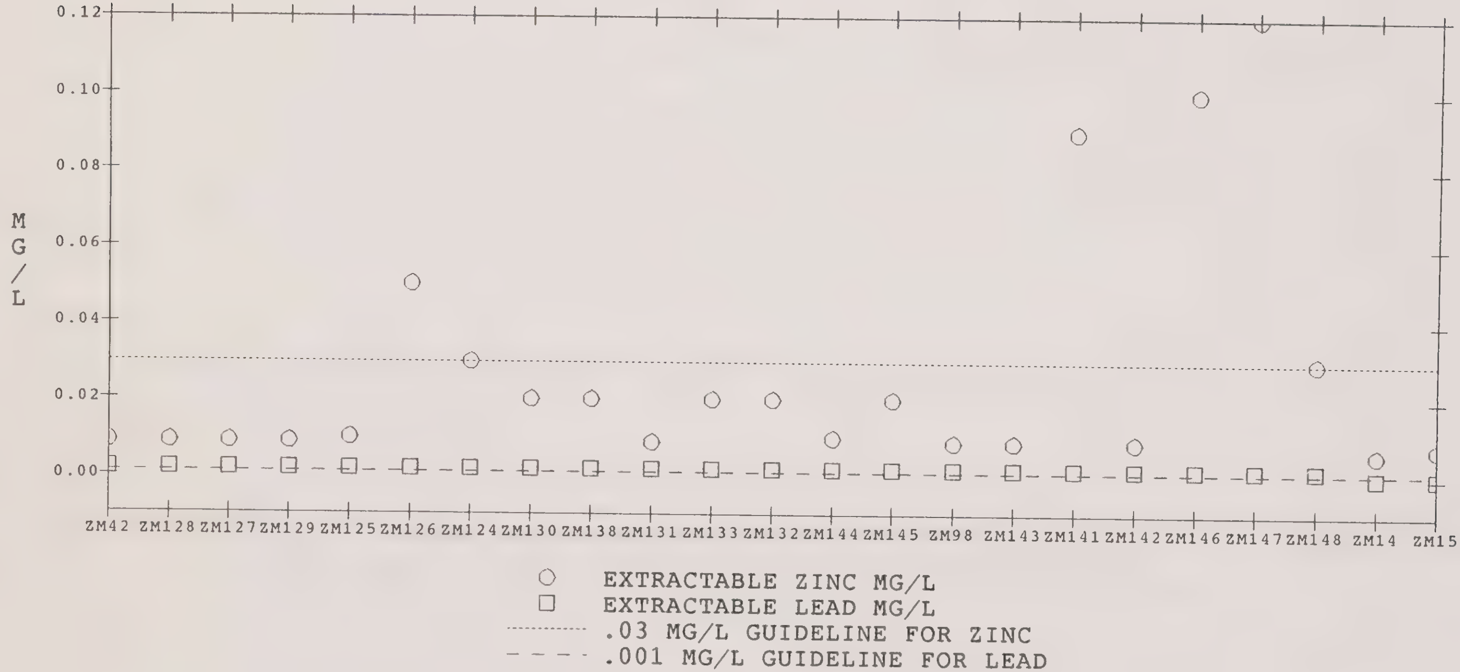
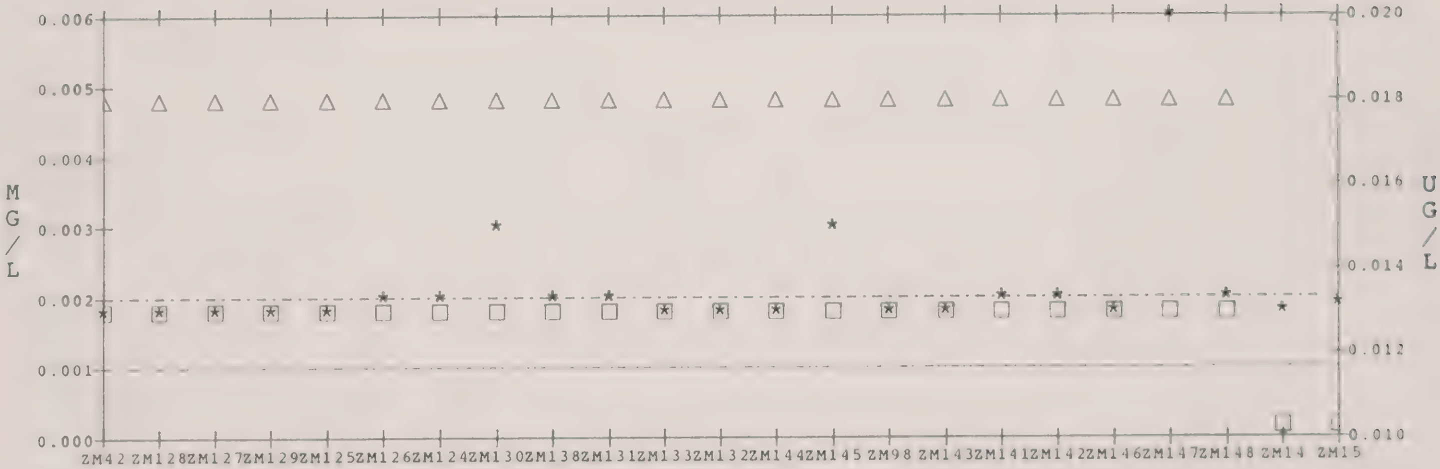
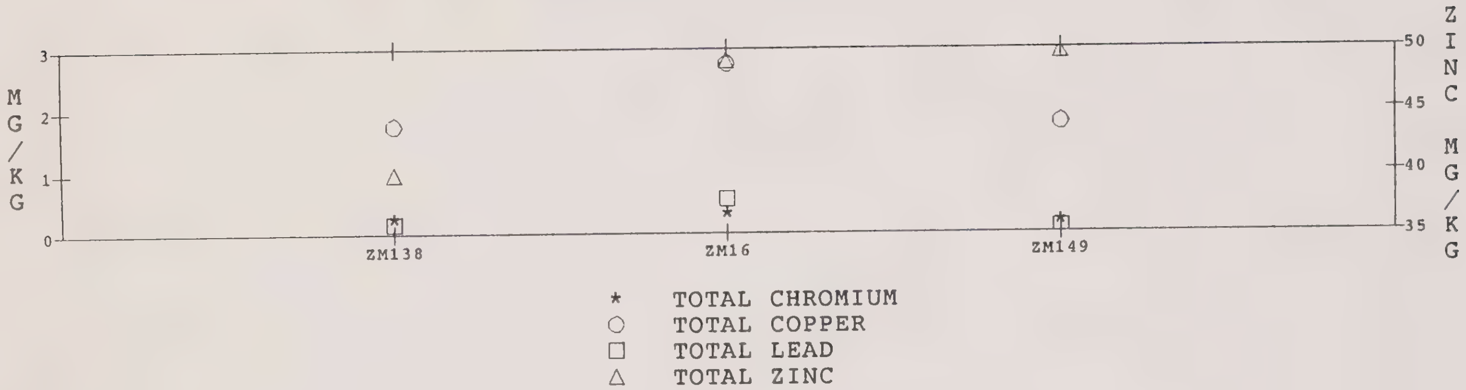


FIGURE 33
HEAVY METALS IN RELATION TO WATER QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE AT STATIONS ON OR ADJACENT TO LEARY'S/RENNIES RIVER AND VIRGINIA RIVER



* EXTRACTABLE COPPER MG/L
□ EXTRACTABLE LEAD MG/L
△ EXTRACTABLE MERCURY UG/L
- - - .01 UG/L GUIDELINE FOR MERCURY
-·-·- .002 MG/L GUIDELINE FOR COPPER
—— .001 MG/L GUIDELINE FOR LEAD (ANALYTICAL DETECTION LIMIT IS <.0018)

FIGURE 34
HEAVY METAL CONCENTRATION (MG/KG) AND PERCENT LIPID BODY WEIGHT (%) OF FORAGE FISH SAMPLES COLLECTED WITHIN THE QUIDI VIDI BASIN BETWEEN AUGUST 06 AND 17, 1990



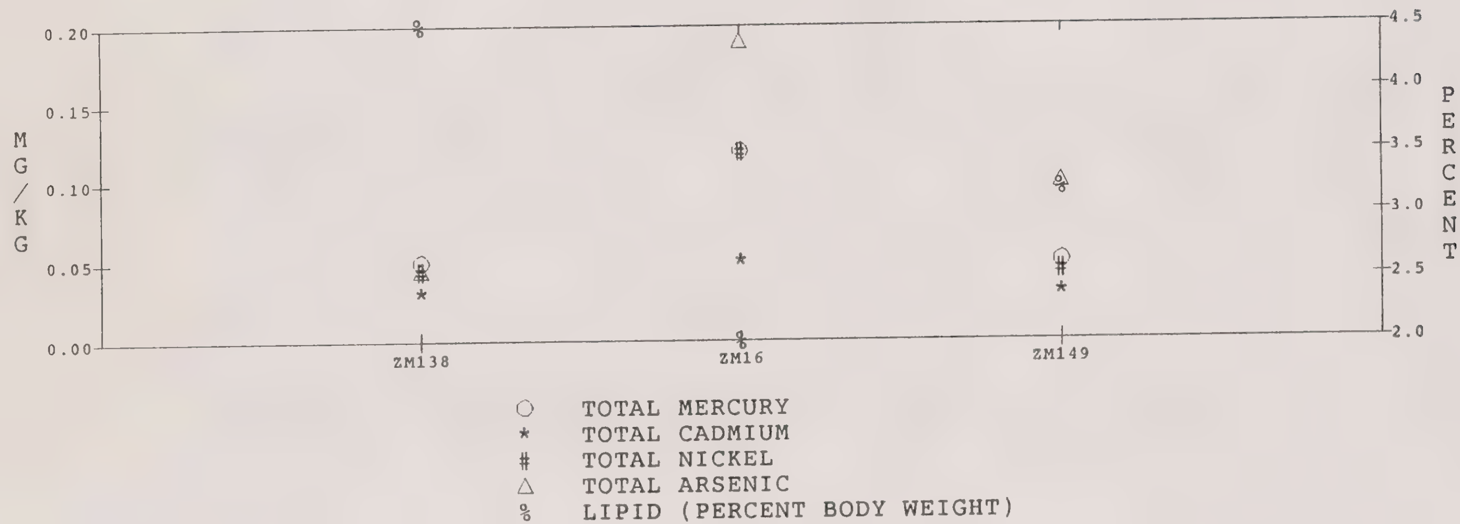
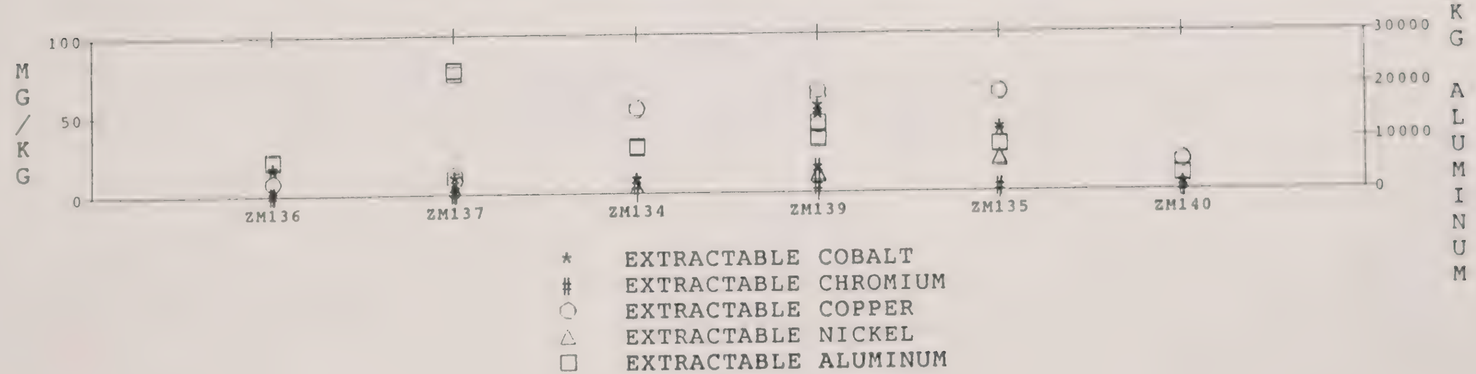


FIGURE 35
HEAVY METAL CONCENTRATIONS (MG/KG) IN RELATION TO THE REFERENCE ELEMENT ALUMINUM (MG/KG) COLLECTED WITHIN THE QUIDI VIDI BASIN BETWEEN AUGUST 06 AND 17, 1990



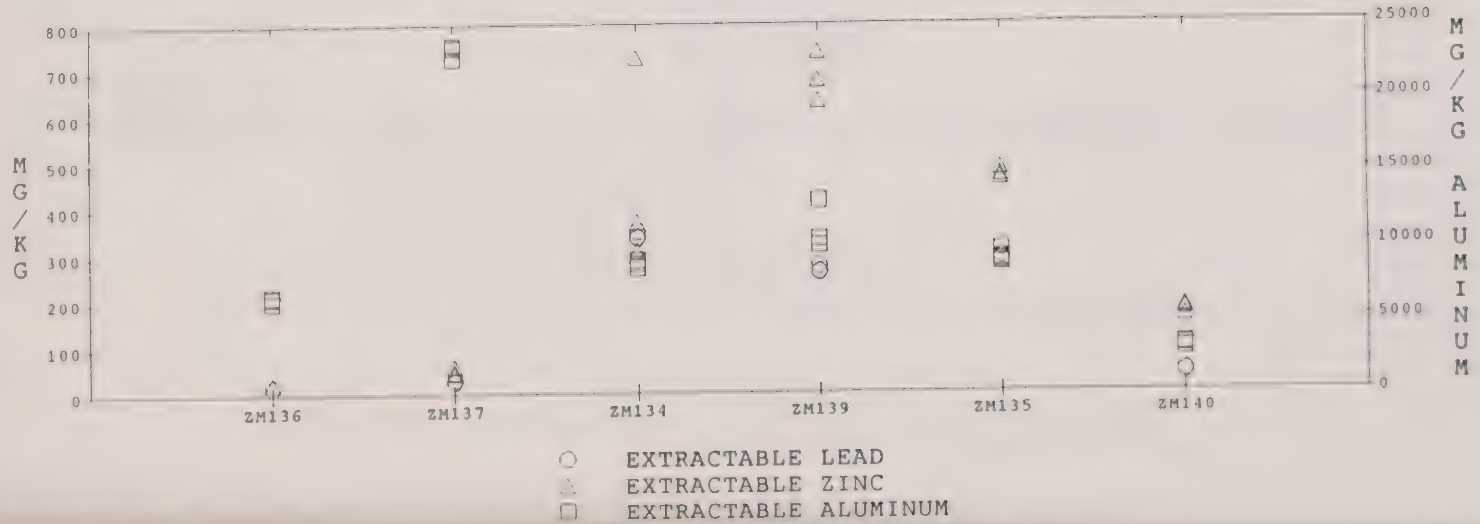


FIGURE 36
SELECTED MAJOR IONS (MG/L) AND SPECIFIC CONDUCTANCE (USIE/CM)
ON THE RENNIES RIVER SITE ZM0016, ABOVE QUIDI VIDI LAKE BETWEEN
1986 AND 1990

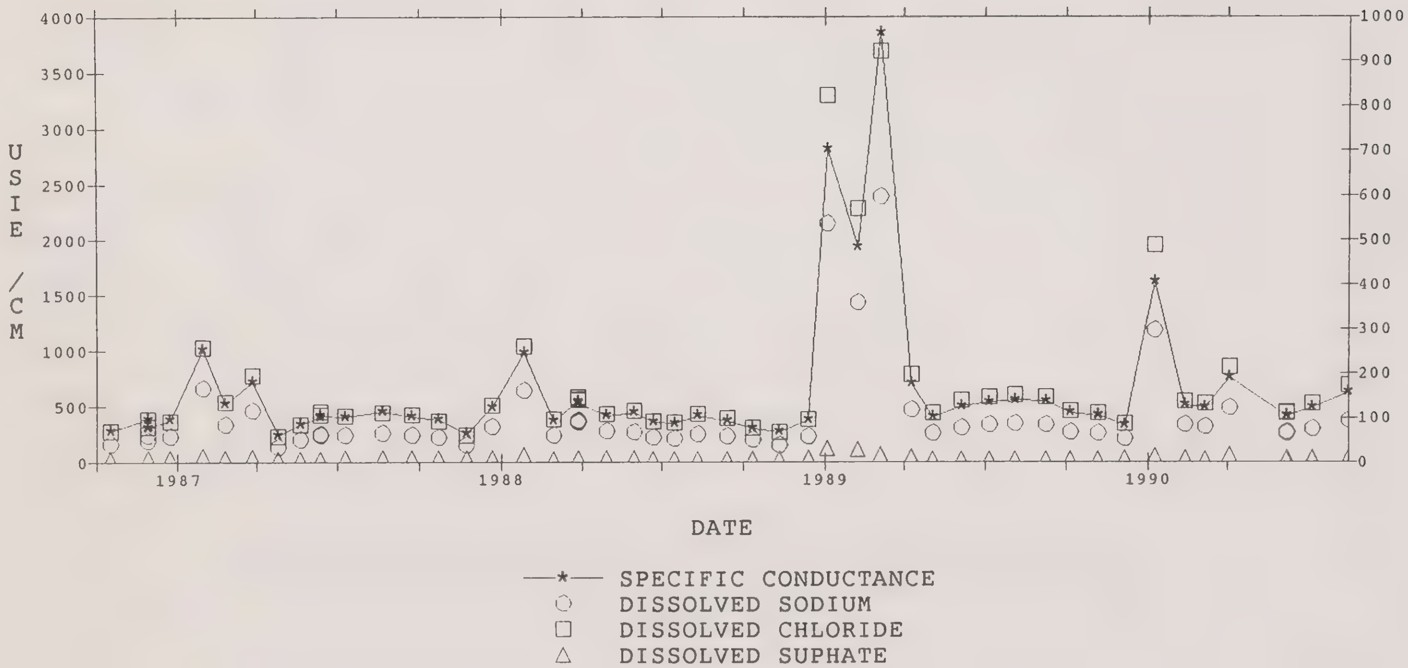


FIGURE 37
THE TEMPORAL RELATIONSHIP OF APPARENT COLOUR TO DISSOLVED ORGANIC CARBON TO EXTRACTABLE IRON AT RENNIES RIVER SITE ZM0016 ABOVE QUIDI VIDI LAKE BETWEEN 1986 TO 1990

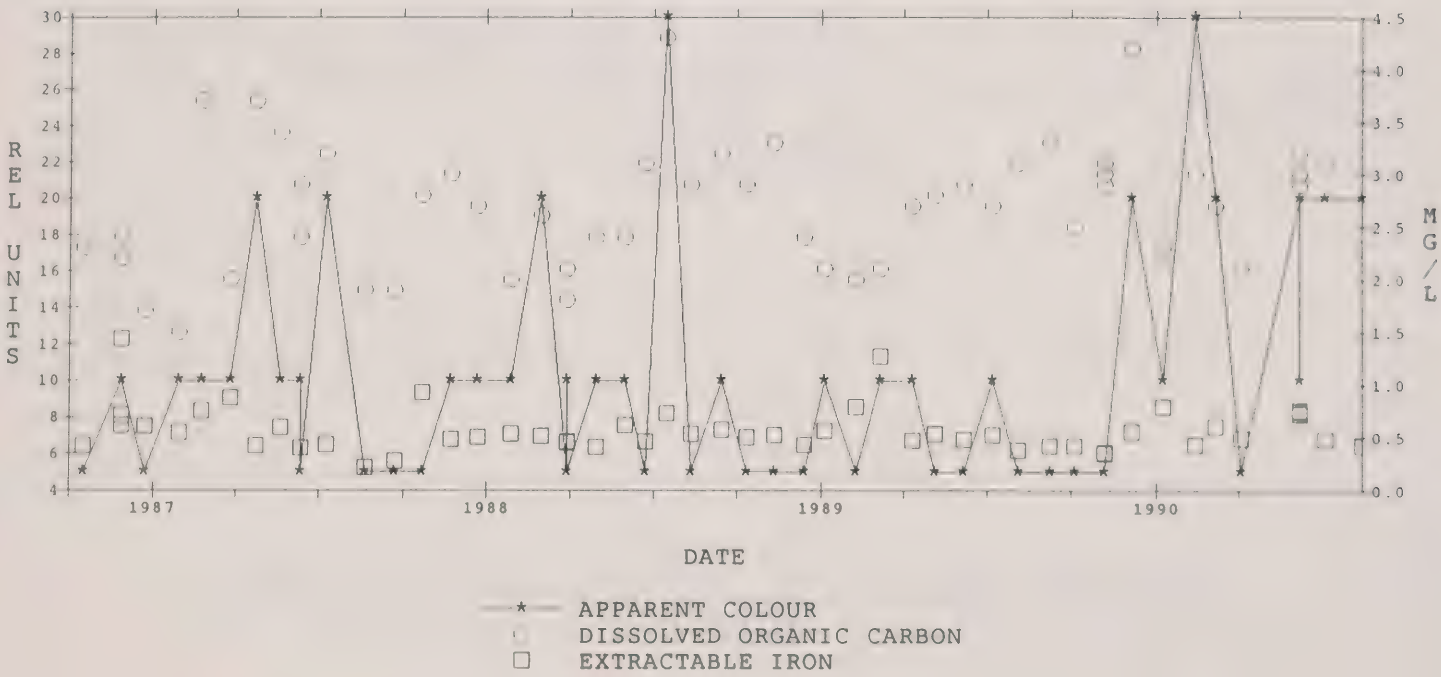


FIGURE 38
THE TEMPORAL RELATIONSHIP OF PH TO ALKALINITY TO SULPHATE TO DISSOLVED ORGANIC CARBON AT RENNIES RIVER SITE ZM0016 ABOVE QUIDI VIDI LAKE BETWEEN 1986 TO 1990

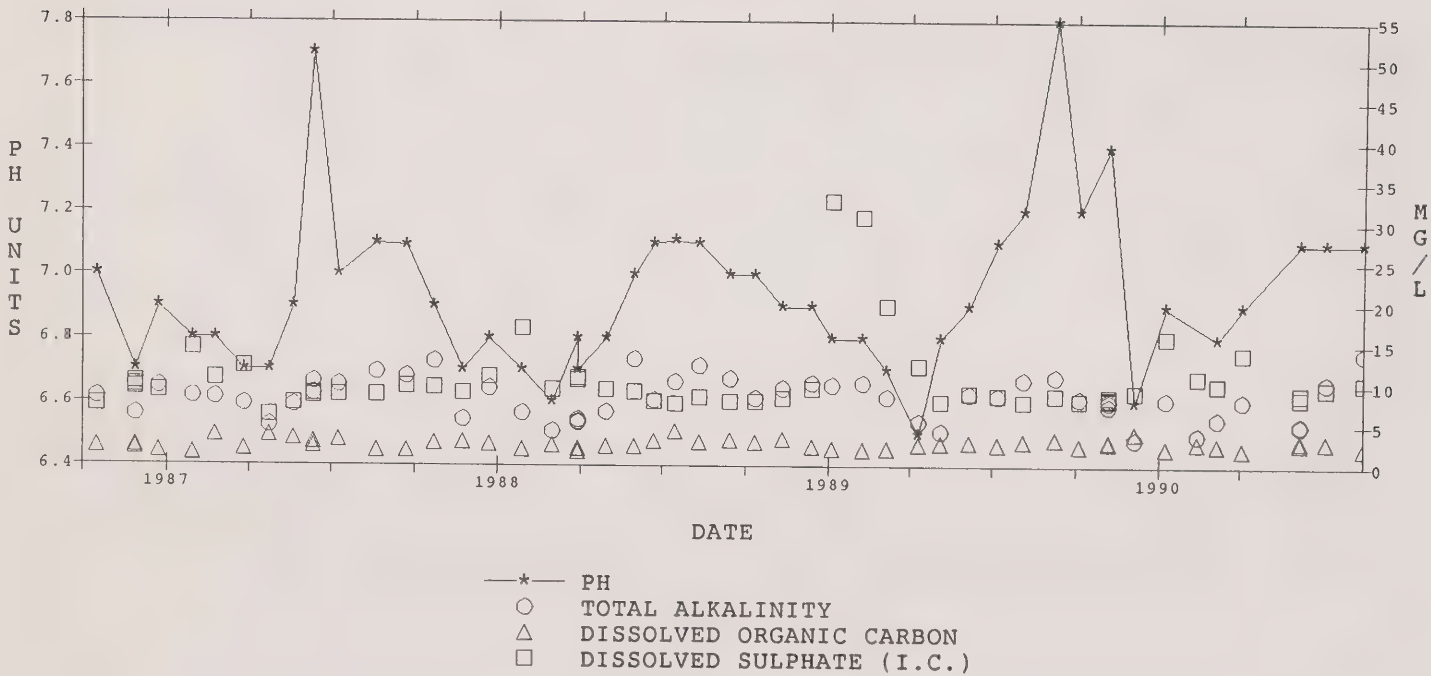


FIGURE 39
THE TEMPORAL CONCENTRATIONS OF HEAVY METALS IN RELATION TO THE WATER QUALITY GUIDELINES FOR THE PROTECTION OF FRESHWATER AQUATIC LIFE AT RENNIES RIVER SITE ZM0016 ABOVE QUIDI VIDI LAKE BETWEEN 1986 TO 1990

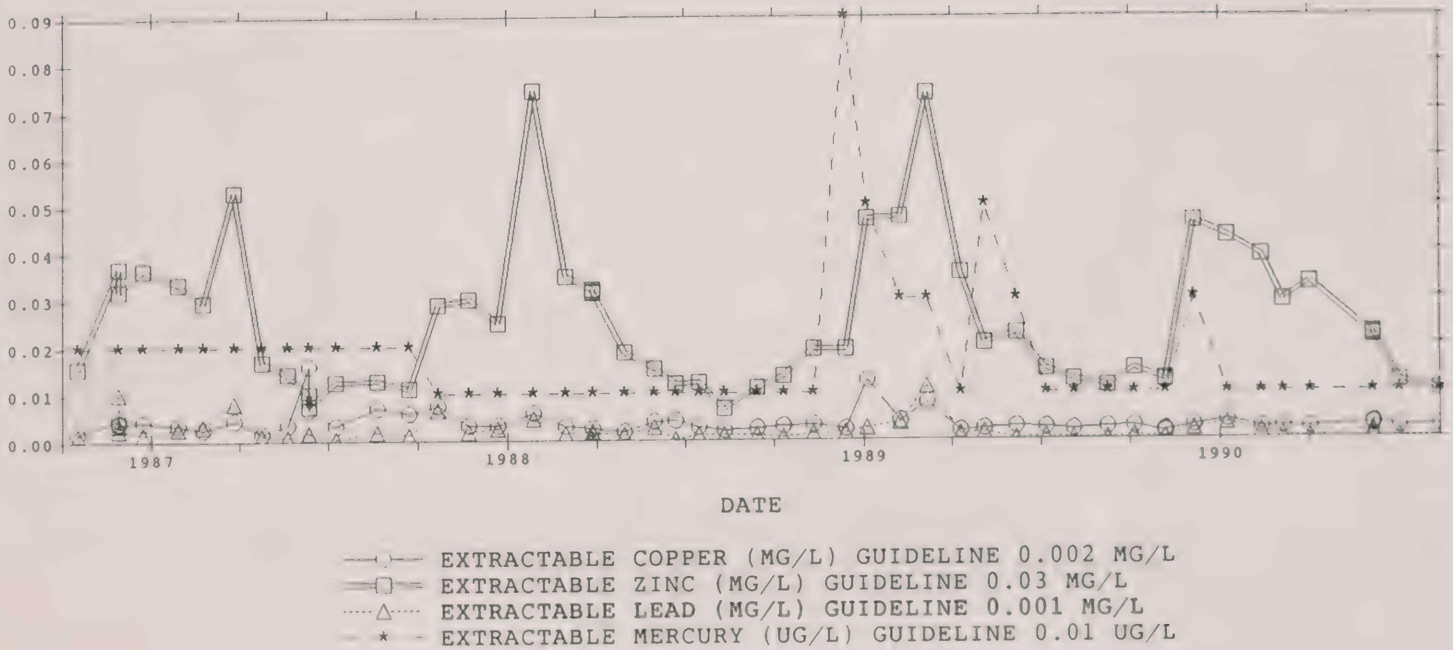


FIGURE 40
SELECTED MAJOR IONS (MG/L) AND SPECIFIC CONDUCTANCE (USIE/CM)
AT THE VIRGINIA RIVER SITE ZM0014 ABOVE QUIDI VIDI LAKE BETWEEN
1986 AND 1990

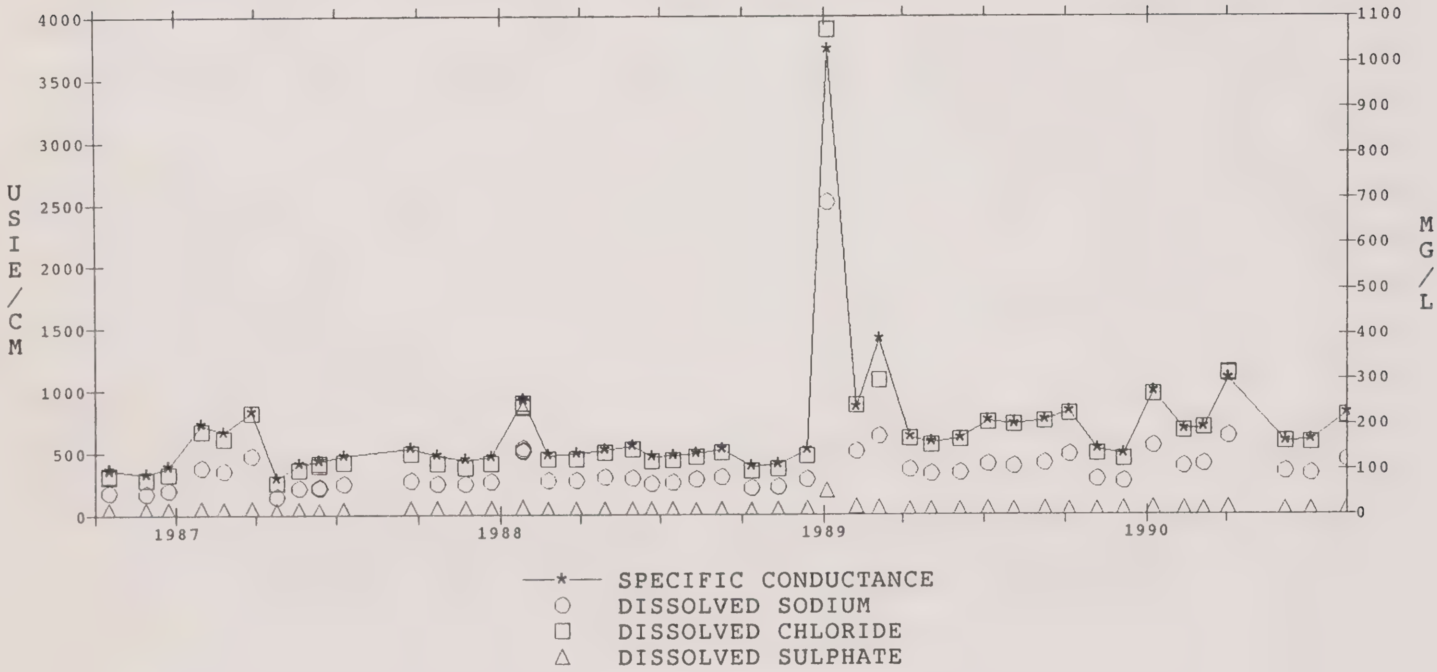


FIGURE 41
THE TEMPORAL RELATIONSHIP OF PH TO ALKALINITY TO SULPHATE TO DISSOLVED ORGANIC CARBON AT VIRGINIA RIVER SITE ZM0014 ABOVE QUIDI VIDI LAKE BETWEEN 1986 TO 1990

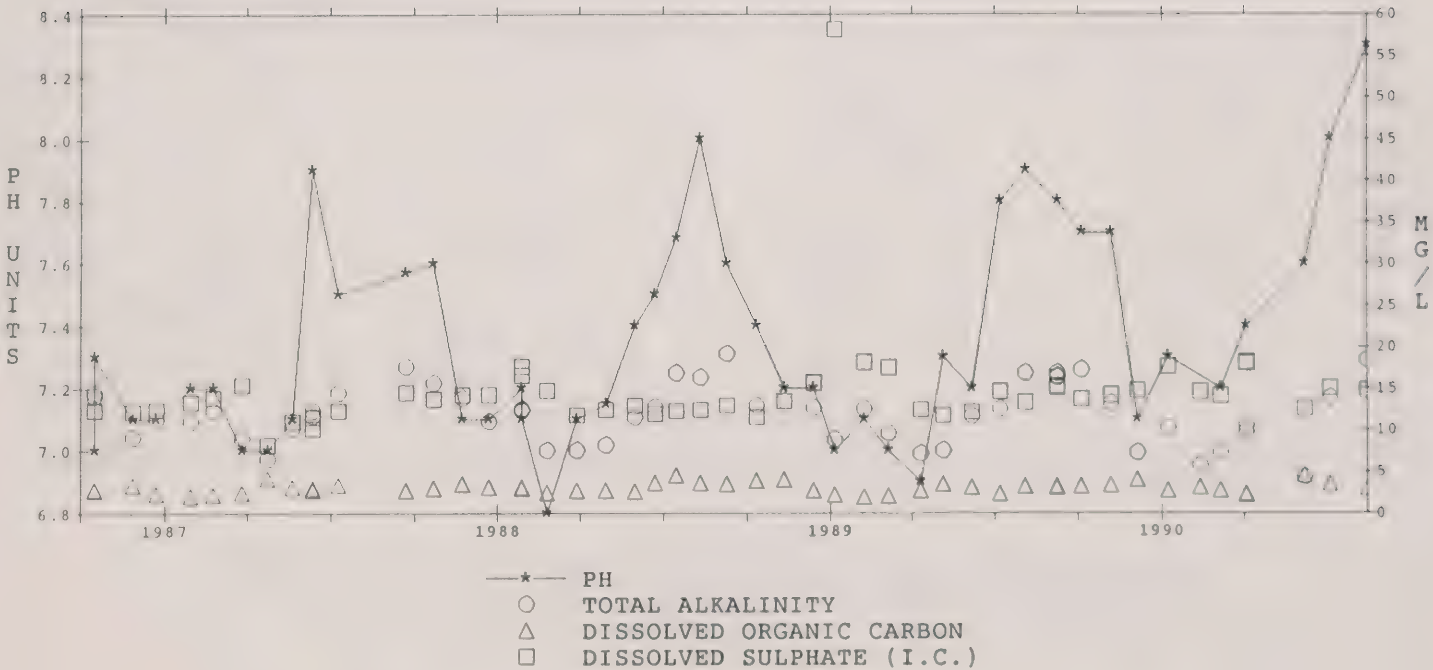


FIGURE 42
THE TEMPORAL RELATIONSHIP OF APPARENT COLOUR TO DISSOLVED ORGANIC CARBON TO EXTRACTABLE IRON AT VIRGINIA RIVER SITE ZM0014 ABOVE QUIDI VIDI LAKE BETWEEN 1986 TO 1990

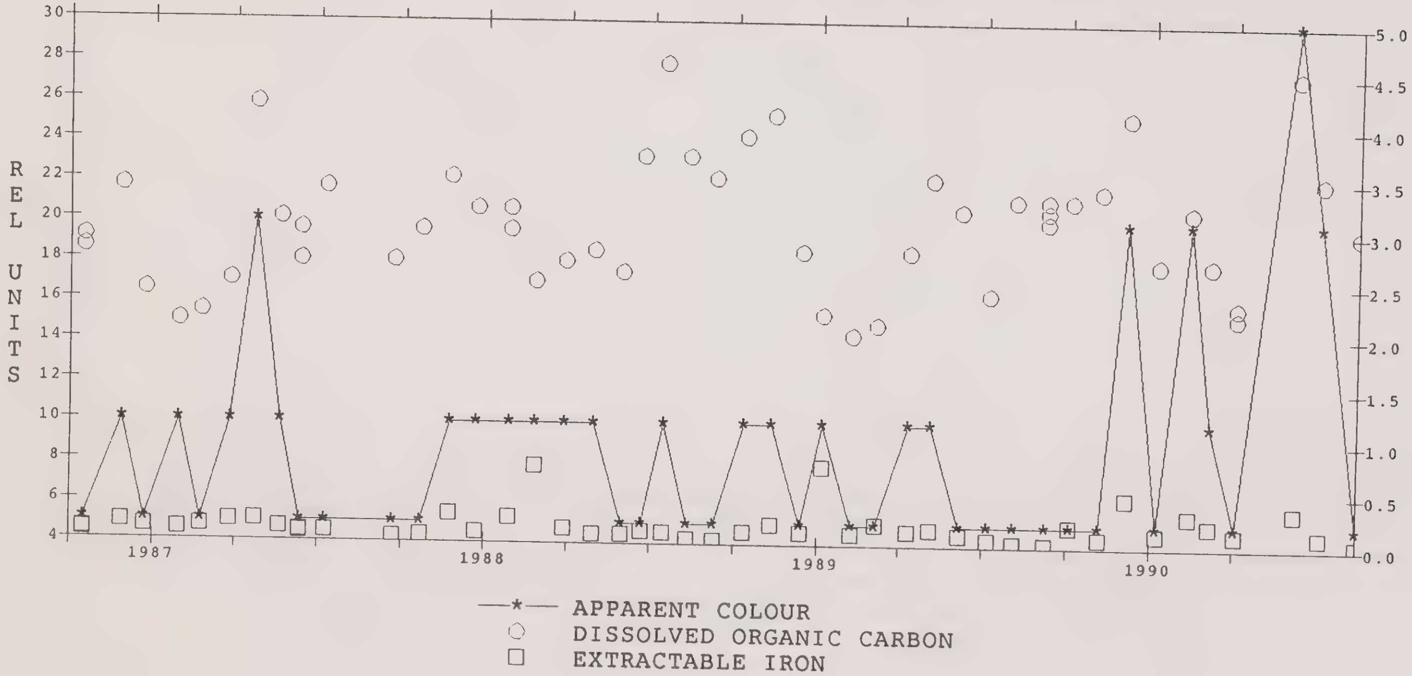


FIGURE 43
THE TEMPORAL CONCENTRATIONS OF HEAVY METALS IN RELATION TO THE WATER QUALITY GUIDELINES FOR THE PROTECTION OF FRESHWATER AQUATIC LIFE AT VIRGINIA RIVER SITE ZM0014 ABOVE QUIDI VIDI LAKE BETWEEN 1986 TO 1990

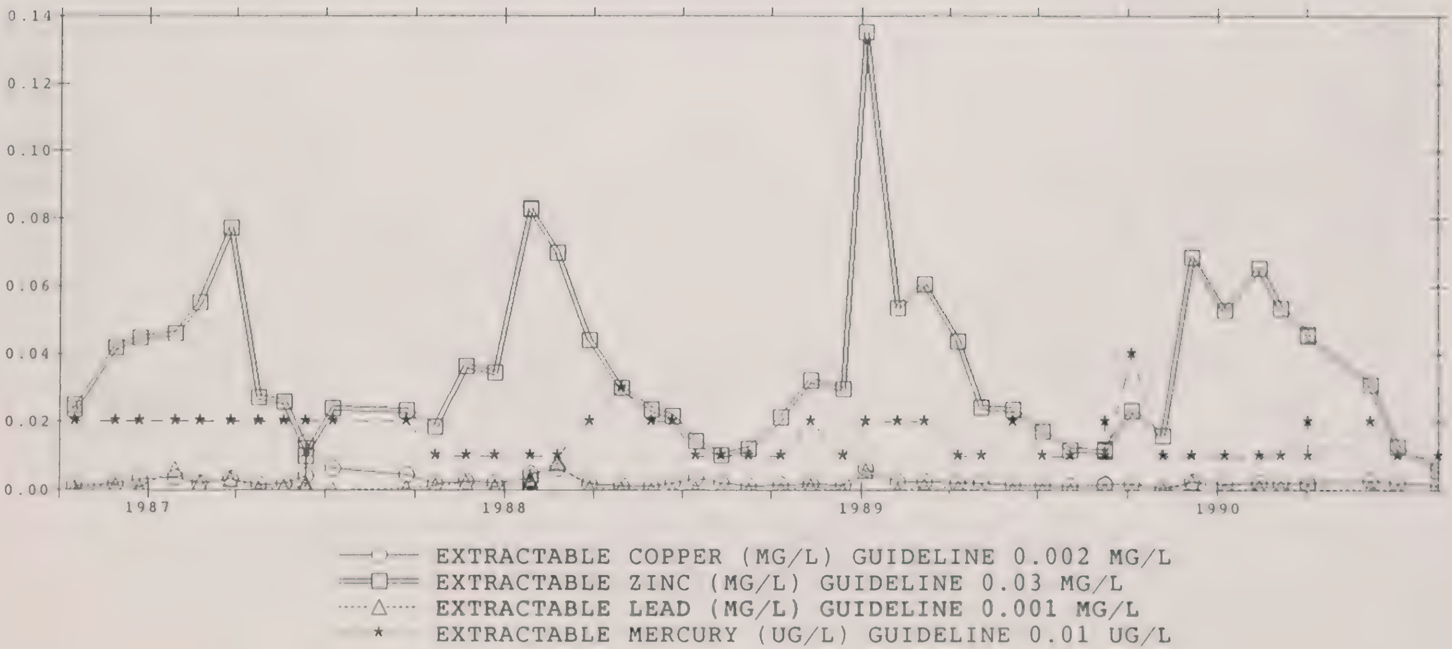


FIGURE 44
THE SPECIFIC CONDUCTANCE (USIE/CM) AT QUIDI VIDI LAKE OUTLET ZM0015 IN COMPARISON TO THAT OF THE TWO TRIBUTARIES RENNIES RIVER ZM0016 AND VIRGINIA RIVER ZM0014 OVER THE PERIOD OF 1986 TO 1990

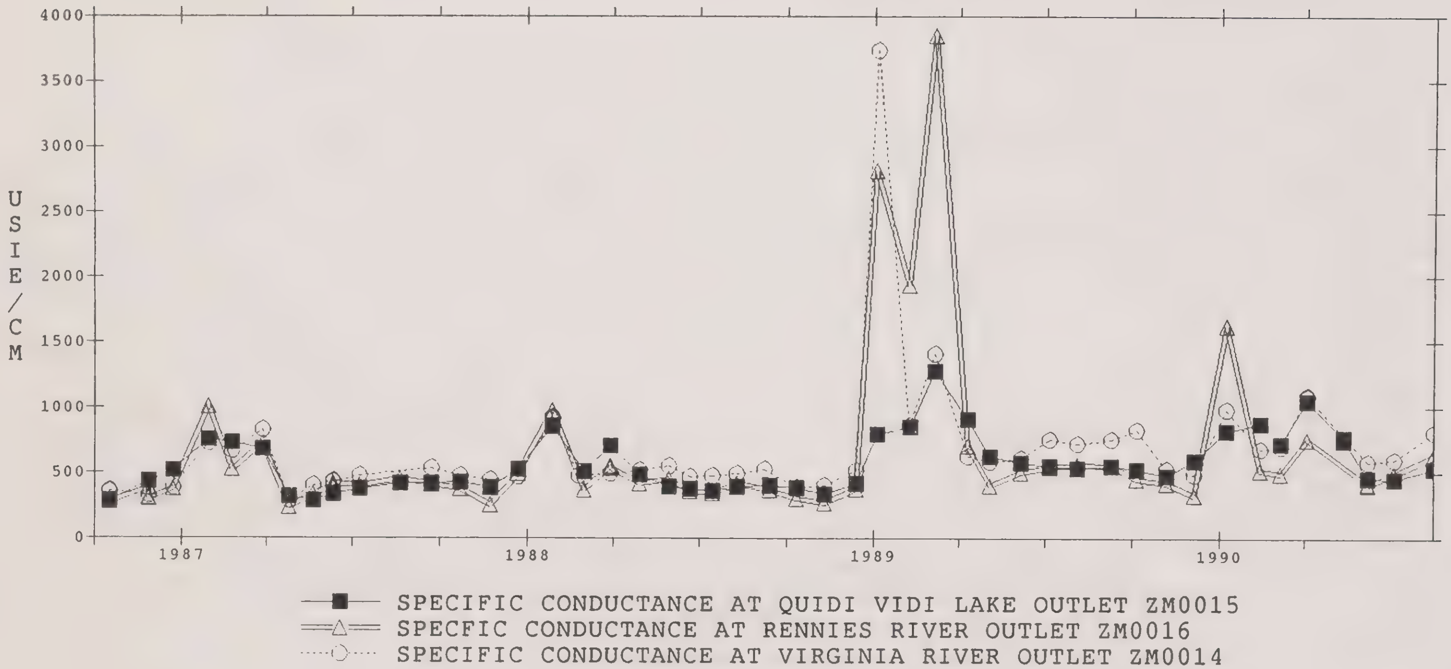


FIGURE 45
SELECT MAJOR IONS (MG/L) AND SPECIFIC CONDUCTANCE (USIE/CM)
AT QUIDI VIDI LAKE OUTLET ZM0015 BETWEEN 1986 TO 1990

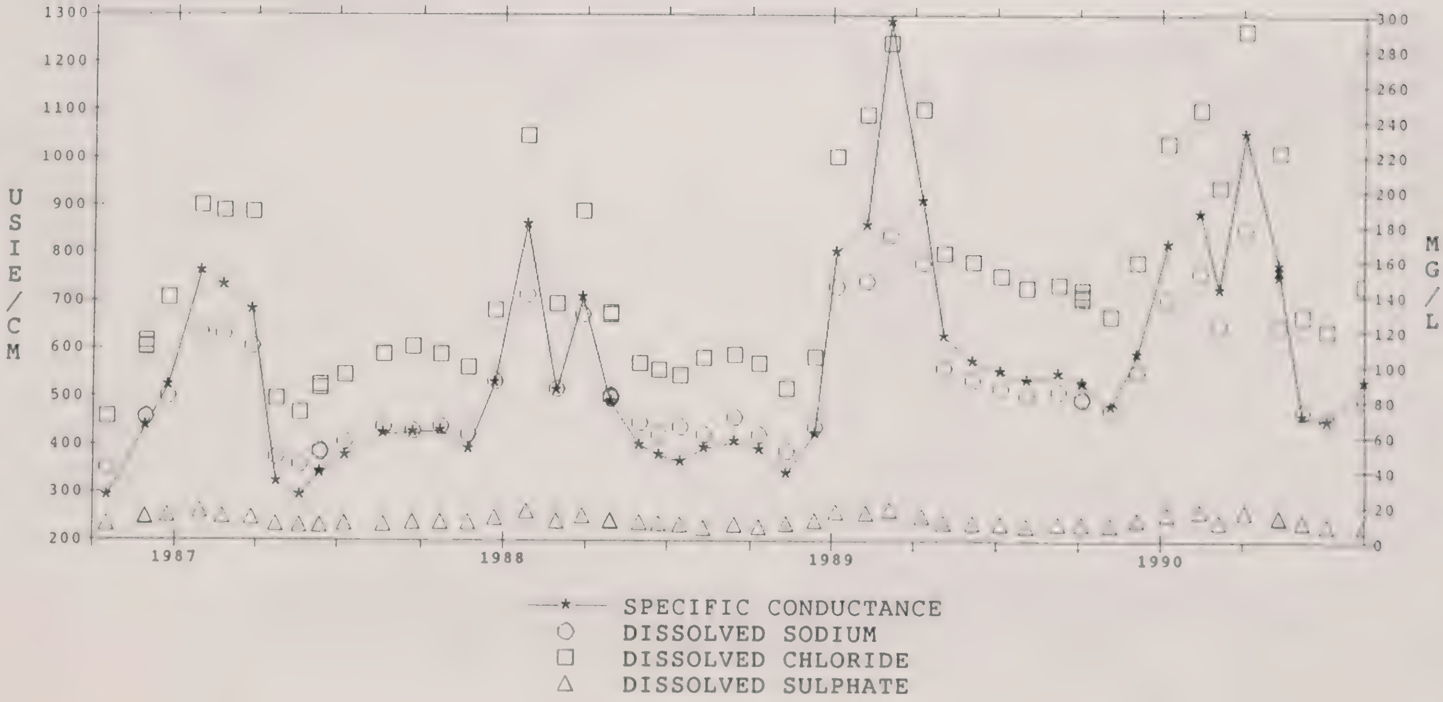


FIGURE 46
THE TEMPORAL RELATIONSHIP OF PH TO ALKALINITY TO SULPHATE TO DISSOLVED ORGANIC CARBON AT QUIDI VIDI LAKE OUTLET ZM0015 BETWEEN 1986 TO 1990

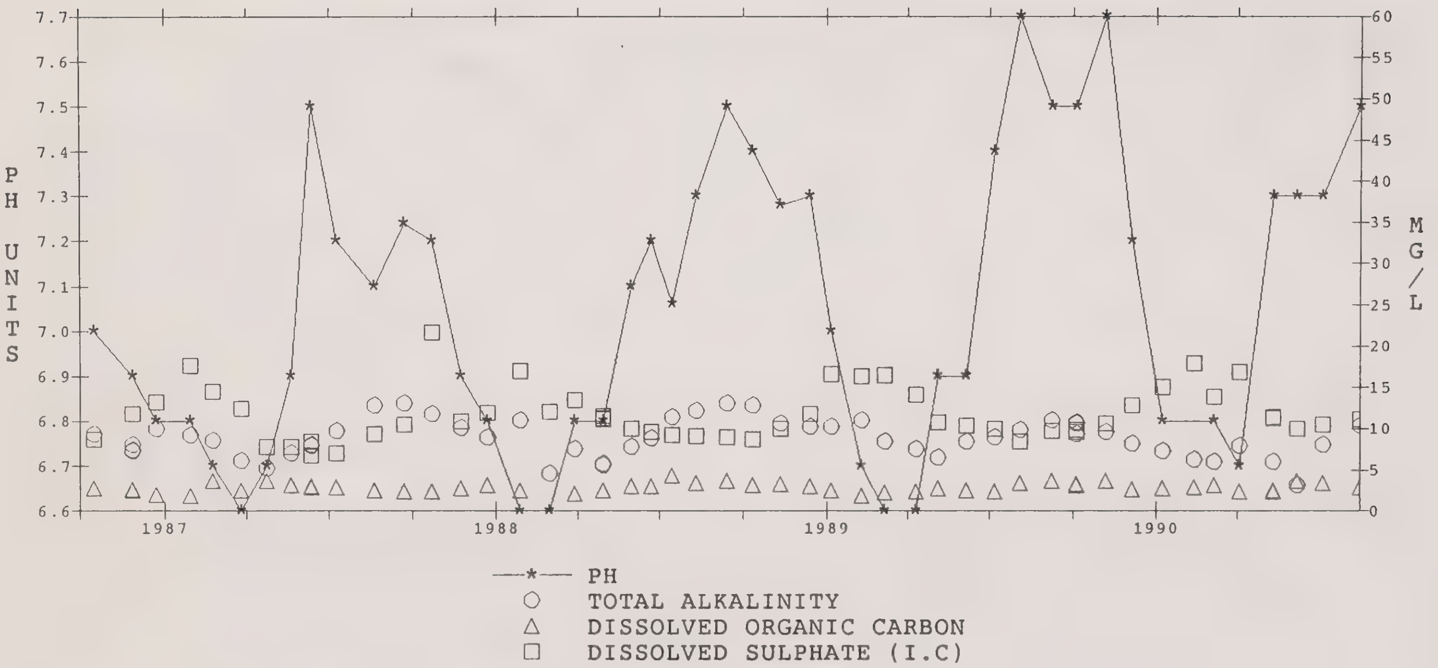


FIGURE 47
THE EXTRACTABLE LEAD CONCENTRATION (MG/L) AT QUIDI VIDI LAKE OUTLET ZM0015 IN COMPARISON TO THAT OF THE TWO TRIBUTARIES RENNIES RIVER ZM0016 AND VIRGINIA RIVER ZM0014 OVER THE PERIOD OF 1986 TO 1990

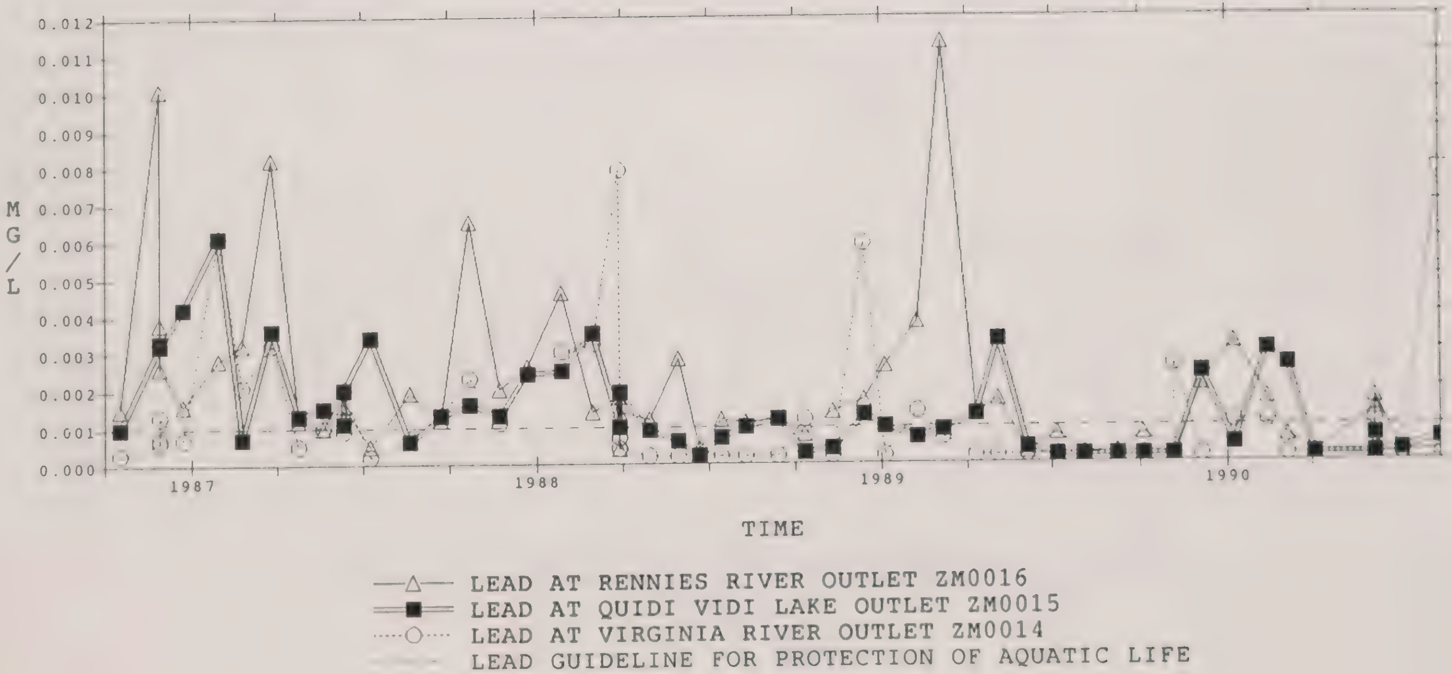


FIGURE 48

THE CONCENTRATION OF EXTRACTABLE MERCURY (UG/L) AT QUIDI VIDI LAKE OUTLET ZM0015 IN COMPARISON TO THAT OF THE TWO TRIBUTARIES RENNIES RIVER ZM0016 AND VIRGINIA RIVER ZM0014 OVER THE PERIOD OF 1986 TO 1990

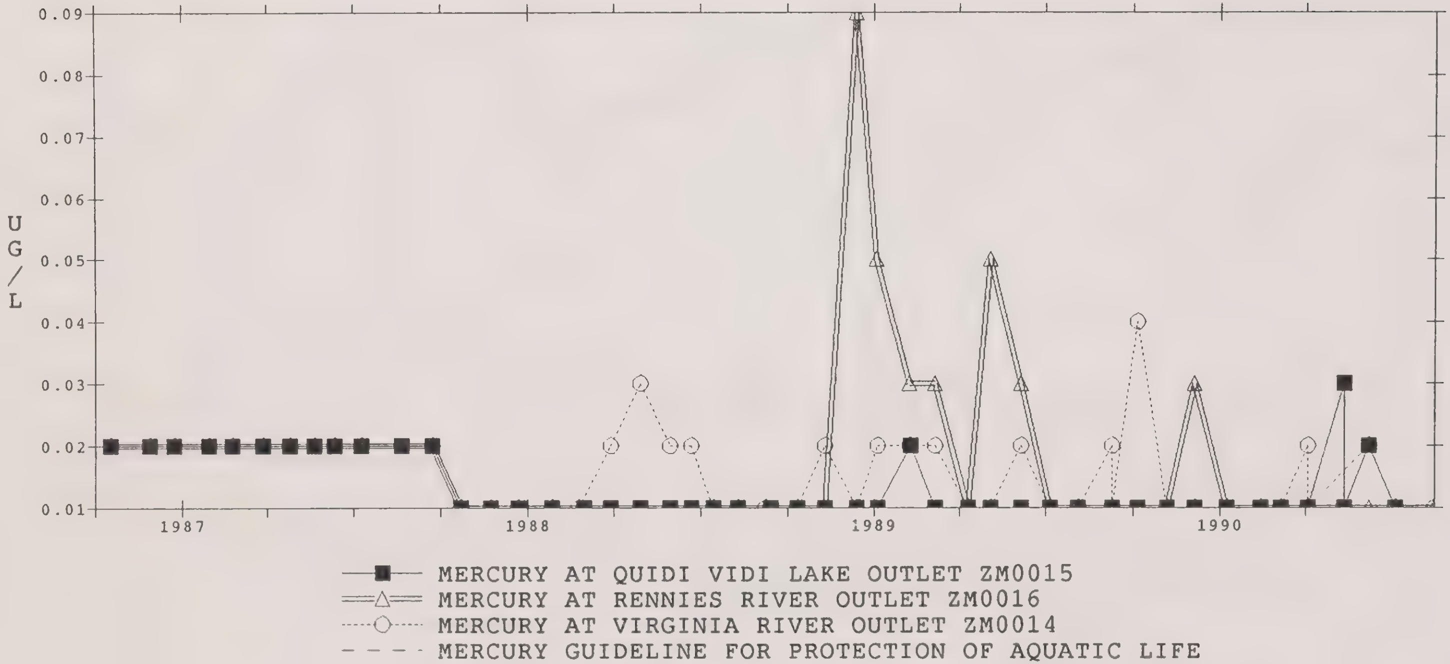


FIGURE 49

THE CONCENTRATION OF EXTRACTABLE ZINC (MG/L) AT QUIDI VIDI LAKE OUTLET ZM0015 IN COMPARISON TO THAT OF THE TWO TRIBUTARIES RENNIES RIVER ZM0016 AND VIRGINIA RIVER ZM0014 OVER THE PERIOD OF 1986 TO 1990

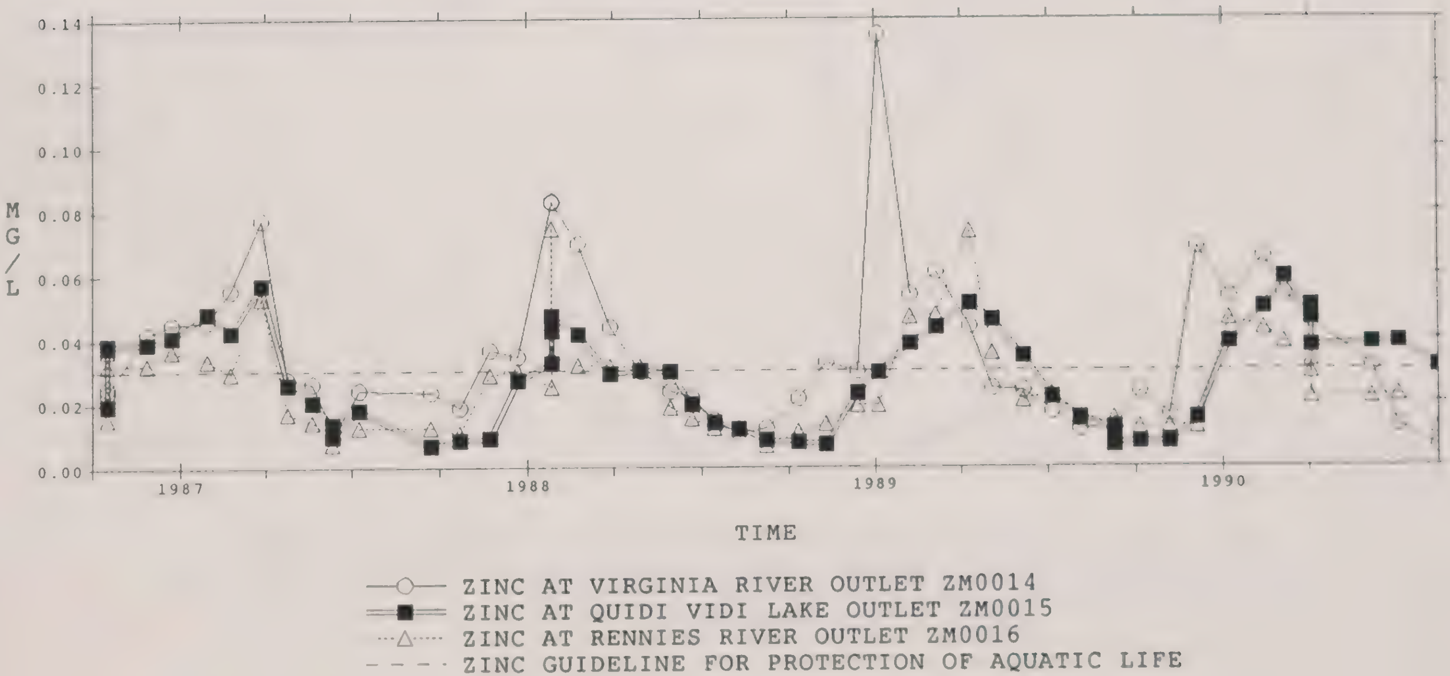
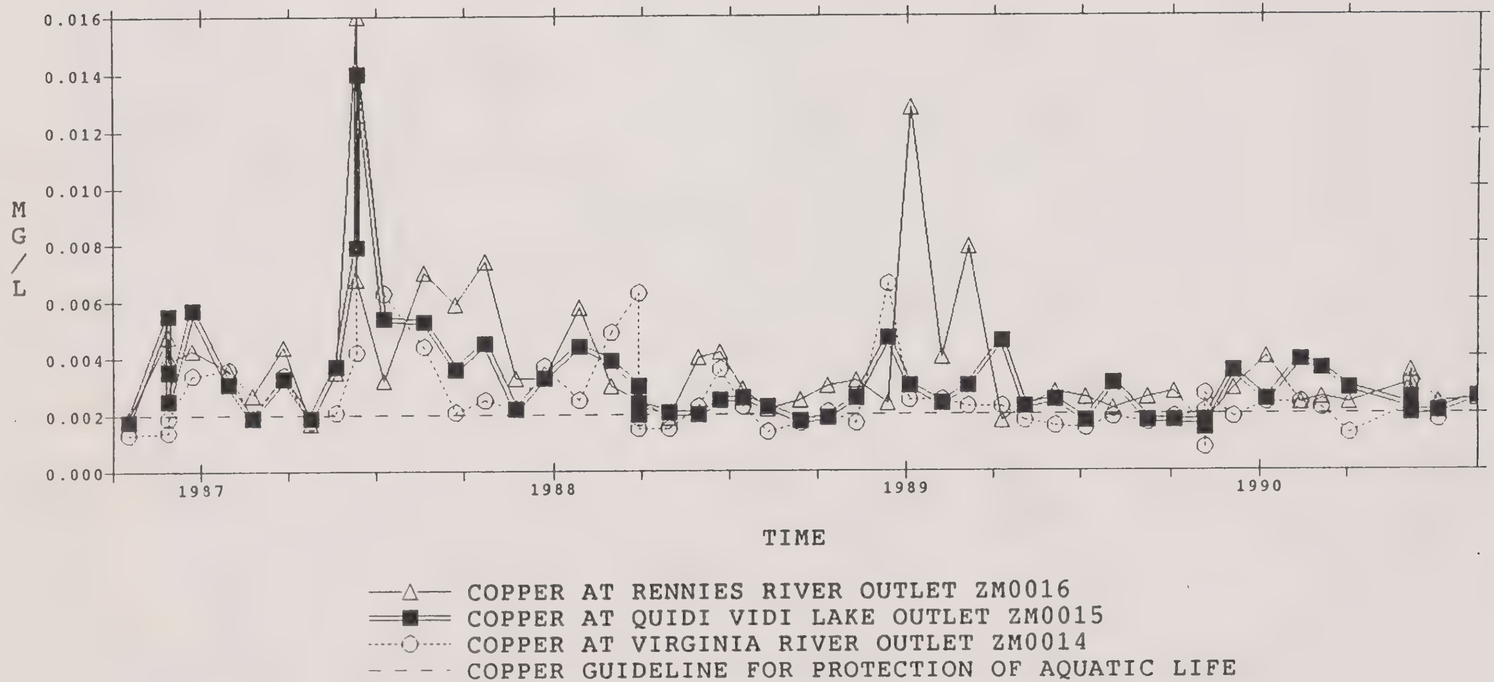
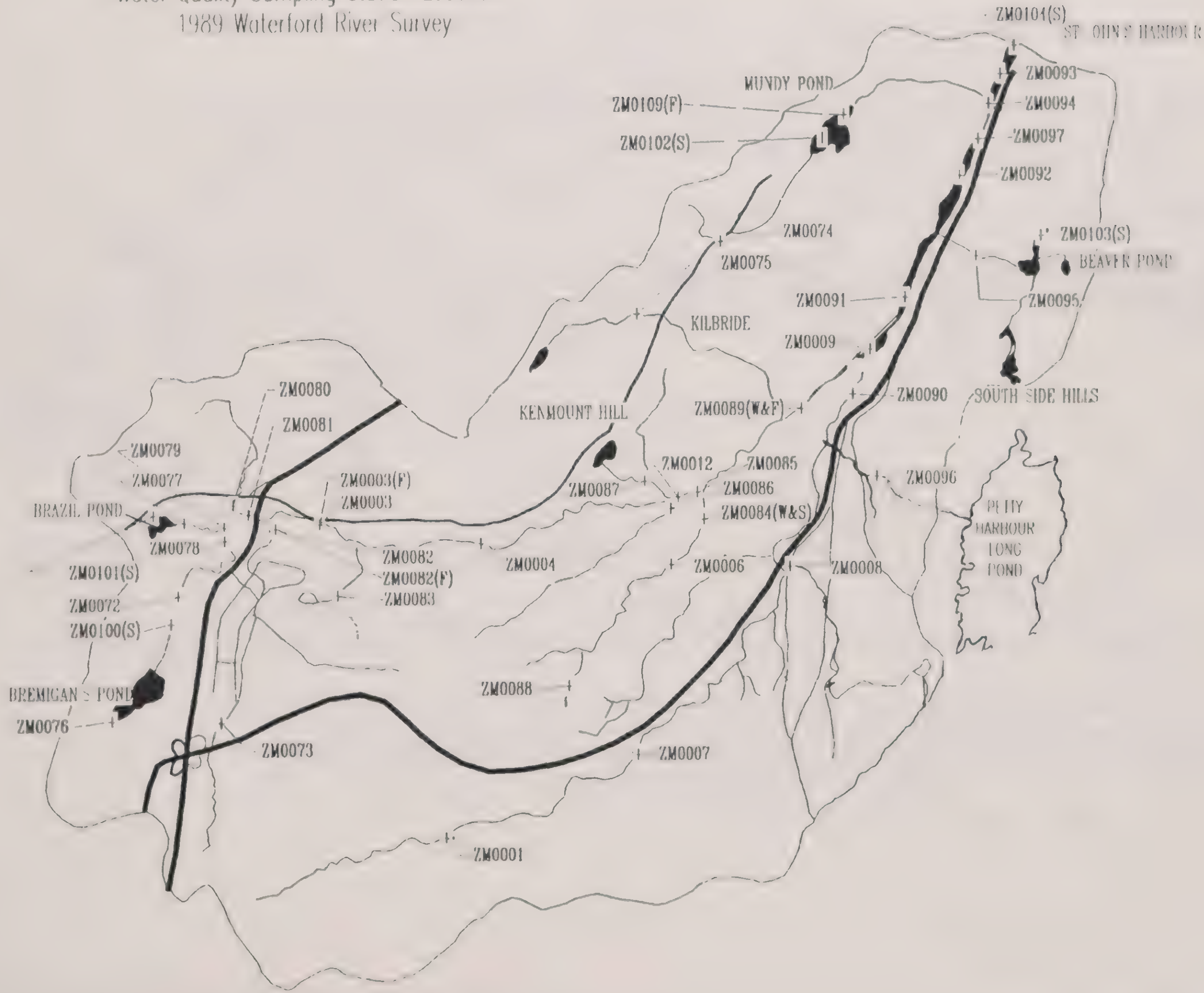


FIGURE 50
THE CONCENTRATION OF EXTRACTABLE COPPER (MG/L) AT QUIDI VIDI LAKE OUTLET ZM0015 IN COMPARISON TO THAT OF THE TWO TRIBUTARIES RENNIES RIVER ZM0016 AND VIRGINIA RIVER ZM0014 OVER THE PERIOD OF 1986 TO 1990



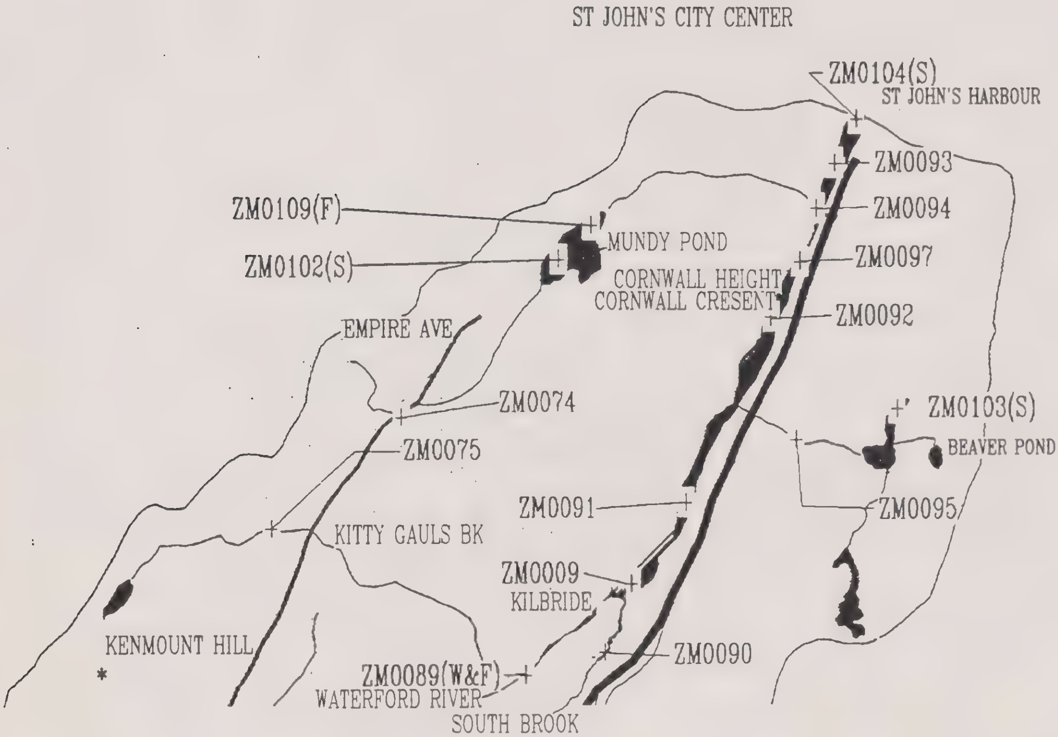
Map 1
Water Quality Sampling Station Locations
1989 Waterford River Survey



MAP 2
THE WATERFORD RIVER BASIN
FROM BREMIGANS POND TO GLENDALE SUBDIVISION

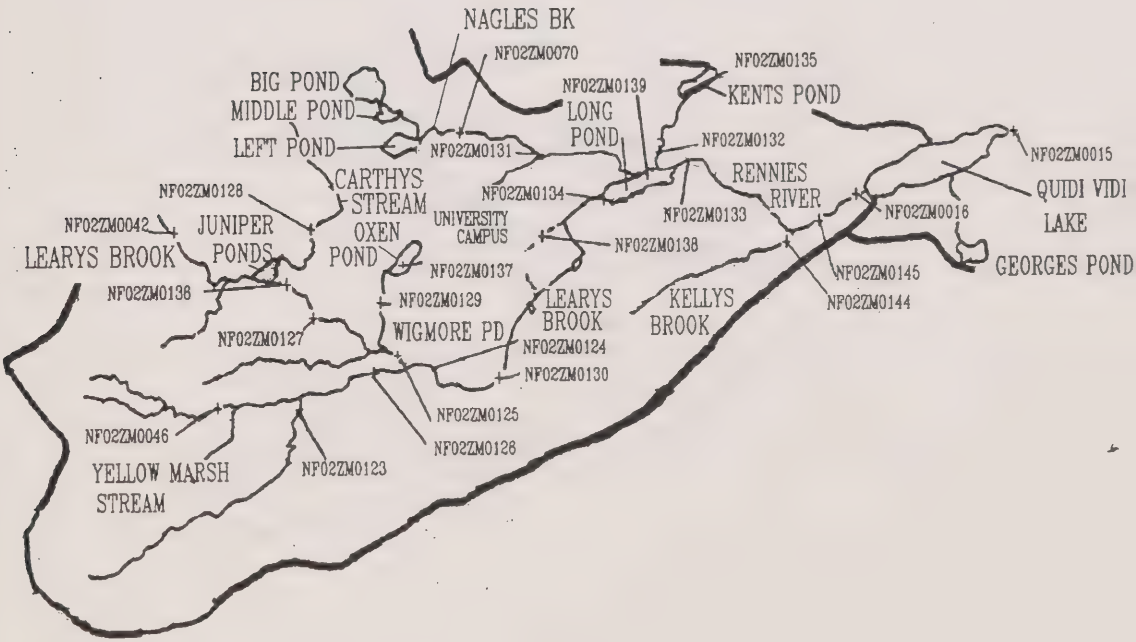
MAP 3
THE WATERFORD RIVER BASIN FROM
DONOVANS TO KILBRIDE

MAP 4
THE WATERFORD RIVER BASIN FROM
KILBRIDE TO THE HARBOUR



MAP 5
WATER QUALITY SAMPLING STATIONS
FOR THE 1990 QUIDI VIDI BASIN SURVEY

MAP 6
WATER QUALITY SAMPLING STATIONS
FOR LEARYS BROOK / RENNIES RIVER



MAP 7
WATER QUALITY SAMPLING STATIONS
FOR VIRGINIA RIVER